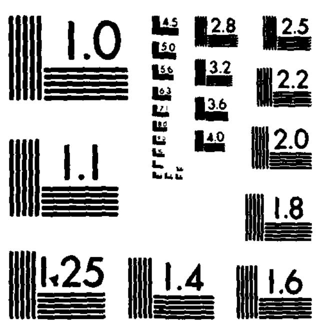
AD-A081 526 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/13
EVALUATION OF COMPUTER PROGRAMS FOR THE DESIGN/ANALYSIS OF HIGH--ETC(U)
JAN 80 W E GALYEAN
UNCLASSIFIED WES-TR-K-80-2 NL

END
DATE
FILMED
3 — 80
DDC



MICROCOPY RESOLUTION TEST CHART

12

LEVEL

ADA081526

TECHNICAL REPORT K-80-2

EVALUATION OF COMPUTER PROGRAMS FOR THE DESIGN/ANALYSIS OF HIGHWAY AND RAILWAY BRIDGES

DTIC
ELECTE
MAR 1 0 1980
S D
A

January 1980

Final Report

A report under the Computer-Aided Structural Engineering (CASE) Project

Approved For Public Release; Distribution Unlimited

80 3 10 051

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

Monitored by Automatic Data Processing Center
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

Destroy this report when no longer needed. Do not return it to the originator.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER (14) WES-TR- Technical Report K-80-2	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) (6) EVALUATION OF COMPUTER PROGRAMS FOR THE DESIGN/ANALYSIS OF HIGHWAY AND RAILWAY BRIDGES		5. TYPE OF REPORT & PERIOD COVERED (9) Final report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) William E. Galyean		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Engineer Waterways Experiment Station ADP Center, P. O. Box 631, Vicksburg, Miss. 39180 with The CASE Task Group on Bridges		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office, Chief of Engineers, U. S. Army Washington, D. C. 20314	(11)	12. REPORT DATE January 1980
		13. NUMBER OF PAGES 80
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) U. S. Army Engineer Waterways Experiment Station Automatic Data Processing Center P. O. Box 631, Vicksburg, Miss. 39180		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

(12) 81

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This report was prepared under the Computer-Aided Structural Engineering (CASE) Project. A list of published CASE reports is printed on the inside of the back cover.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Bridge design
Computer-Aided Structural Engineering Project
Computer programs
Highway bridges
Railway bridges

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of this report is to recommend computer programs for Corps-wide application in the design/analysis of highway and railway bridges. The CASE Task Group on Bridges compiled a list of bridge programs presently in use by Corps designers and various state highway departments and then evaluated and selected the most appropriate ones for Corps-wide use. The programs were evaluated based on the following considerations: (a) Corps designers should be familiar with use of the program; (b) highway programs should be acceptable to

(continued)

next page

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

038100

cont.

20. ABSTRACT (continued)

the various state departments of transportation; (c) highway programs should conform to AASHTO (American Association of State Highway and Transportation Officials) specifications; (d) railway programs should be acceptable to the various railroad companies; and (e) railway programs should conform to AREA (American Railroad Engineering Association) specifications.

This report describes four highway and three railway computer programs selected by the Task Group, lists their capabilities and limitations, and shows example runs.

Accession For

/or
al

A

Preface

In November 1976, the Office, Chief of Engineers, U. S. Army (OCE), funded the Computer-Aided Structural Engineering (CASE) Project to examine, evaluate, and propose steps to overcome problems in computer-aided structural engineering throughout the Corps and to coordinate and guide long-term computer-aided design efforts on a Corps-wide basis. As part of this effort, several technical task groups were established to coordinate program development in specific areas of computer applications. The CASE Task Group on Bridges was one of the first six task groups formed for this purpose.

The primary function of the CASE Task Group on Bridges has been to compile a list of bridge computer programs presently in use and to evaluate and select the most appropriate ones for Corps-wide use. This report is a summary of the results of the program evaluations and contains the recommendations and conclusions of the Task Group.

Subsequent to the start of the CASE Project, the National Cooperative Highway Research Program (NCHRP) funded a comprehensive survey study on available highway bridge programs and recommendations for developing an integrated bridge design program. The U. S. Army Engineer Waterways Experiment Station (WES) awarded a contract to Dr. David R. Schelling of the University of Maryland, who was one of the investigators in the NCHRP study, to summarize the study findings. A report prepared by Dr. Schelling has been published by WES under separate cover as a companion to this report. AO81501 The appendices to Dr. Schelling's report contain raw survey data and are available from the CASE Project Manager, Dr. N. Radhakrishnan, Special Technical Assistant, Automatic Data Processing (ADP) Center, WES.

The following were members of the Task Group on Bridges:

- William E. Galyean, Huntington District (Chairman)
- Richard M. Chun, Pacific Ocean Division
- James Gibson, Mobile District
- Gregory Griffith, Wilmington District
- Arthur T. Shak, Pacific Ocean Division

Mr. William D. Ashton, formerly with the Rock Island District, served as the first Chairman of the Task Group. Messrs. David Shaw and Carlton E. Smith, St. Louis District, were also members of the Task Group during

the survey preparation and evaluation phases of the work.

Mr. Donald R. Dressler, Structures Branch, Civil Works Directorate, was OCE's point of contact. Dr. Radhakrishnan, as CASE Project Manager, coordinated and monitored the work. Messrs. Paul K. Senter and H. Wayne Jones, Computer-Aided Design Group, ADP Center, WES, converted all the programs to the WES, Macon, and Boeing computers and supported the Task Group in the preparation of this report. Mr. Galyean compiled this report for the Task Group. Mr. D. L. Neumann was Chief of the ADP Center, WES, during the study and the preparation of the report.

Directors of WES during this period were COL J. L. Cannon, CE, and COL N. P. Conover, CE. Technical Director was Mr. F. R. Brown.

Contents

Conversion Factors, U. S. Customary to Metric (SI) Units of Measurement

U. S. customary units of measurement used in this report can be converted to metric (SI) as follows:

Multiply	By	To Obtain
feet	0.3048	metres
foot-kips (force)	1.355818	metre-kilonewtons
inches	2.54	centimetres
kips (1000 lb force)	4.448222	kilonewtons
kips (force) per square inch	6.894757	megapascals
miles (U. S. statute) per hour	1.609344	kilometres per hour
pounds (force) per foot	14.5939	newtons per metre
pounds (force) per square inch	6.894757	kilopascals
tons (2000 lb mass)	907.18474	kilograms

EVALUATION OF COMPUTER PROGRAMS FOR THE DESIGN/ANALYSIS OF HIGHWAY AND RAILWAY BRIDGES

Purpose

1. The purpose of this report is to recommend computer programs for Corps-wide applications in the design/analysis of highway and railway bridges. Since bridge programs cover a wide range of capabilities, only those programs that are likely to address applications which are expected to have wide use are covered. It is not justified to utilize computer storage space for programs which are infrequently used. Also, such programs will require maintenance. In most instances, alternate programs which can solve these problems are available.

Types of Programs

2. Bridge programs in this report are divided into two broad classifications, highway and railway. For evaluation, each classification in turn is divided into several areas of application. Programs recommended for Corps-wide application are based on need in each area of application. Each Corps office was contacted to determine its needs and preferences.

Evaluation

3. The primary function of the CASE Task Group on Bridges was to compile a list of bridge programs presently in use by Corps designers and the state highway departments and to evaluate and select the most appropriate ones for Corps-wide use. The programs were evaluated based on the following considerations:

- a. Corps designers should be familiar with use of the program.
- b. Highway programs should be acceptable to the various State Departments of Transportation.

_c_. Highway programs should conform to AASHTO (American Association of State Highway and Transportation Officials) specifications.

_d_. Railway programs should be acceptable to the various railroad companies.

_e_. Railway programs should conform to AREA (American Railroad Engineering Association) specifications.

Scope of Report

4. This report describes four highway and three railway computer programs selected by the Task Group and lists their capabilities and limitations. Example computer runs for each of the programs are included in Appendix A. Documentation of these programs may be obtained from the Engineering Computer Programs Library (ECPL) of the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss. This report refers to a more comprehensive survey and recommendations made in a project funded by the National Cooperative Highway Research Program (NCHRP). The NCHRP project findings are published separately in another WES report ("Survey of Bridge-Oriented Design Software," Technical Report K-80-1, Jan 1980, by David R. Schelling).

Programs Selected

General

5. The Task Group, based on a wide search that included queries to all field offices, selected four highway and three railway computer programs as best suited to meet the Corps' needs. One highway program was selected that also can be used for railway-type structures. The highway programs were recommended by the Highway Engineers Exchange Program (HEEP) and are used by many states. (HEEP has plans to develop an integrated bridge design program for highway bridge design.) The railway programs were developed by the Association of American Railroads Research Center (AARRC). These programs are acceptable to the various railroad companies. The applications of each program are indicated in Table 1,

Table 1

Programs and Applications

Program	Classification: Highway	Classification: Railway	Application
BRHPSG	X	X	Prestressed concrete
BRHCBA	X		Continuous beam analysis (composite or noncomposite)
BRHMCP	X		Multiple column pier analysis
BRHGEO	X		Geometric solution of highway bridges
BRRPLG		X	Analysis and rating of plate girders and beams
BRRTRU		X	Analysis of trusses
BRRTRR		X	Rating of trusses

and their salient features are described below. These programs are not intended to cover nonstandard highway or railway loadings consisting of special wheel loads. For such applications of unusual loads, programs "INFORD" and "WTRAIN" are available as part of the CORPS (Conversationally Oriented Real-Time Program-Generating System) library maintained by WES on the WES, Macon, and Boeing computers.

BRHPSG (Analysis and Design of Simple Span Precast-Prestressed Highway or Railway Bridges)

6. This computer program was developed by the Portland Cement Association for the analysis and design of simple span, composite and noncomposite, precast-prestressed highway or railway bridges. The program is based on conventional design procedures and on appropriate sections of the 1977 AASHTO specifications and 1968 AREA specifications. The program is limited to the analysis and design of simple span, precast-prestressed highway or railway bridges. It will accommodate any section for which section properties are known and can be adequately described by the input variables. This program is now part of the CORPS library at WES. The timesharing version provides the user with a free field

read format and an interactive question/response option for inputting data. The program calculates section properties for single or double-cell box beams. The standard AASHTO loadings are used for highway bridges. Coopers "E" loading is used for railway bridges.

7. Some capabilities of the program are summarized below:

a. Section properties for standard precast sections.

b. Dead and live load shears and moments.

c. Stresses for various loading conditions.

d. Ultimate design (load factor) moments and resisting moments.

e. Spacing of shear reinforcement.

f. Horizontal shear stress between composite slabs and precast members.

g. Midspan elastic deflections for various loading conditions.

h. Number and center of gravity of prestressing strands required.

Other capabilities are fully described in the User's Manual.

BRHCBA (Analysis of Continuous Beams for Highway Bridges)

8. This program was developed by the Georgia Department of Transportation for the analysis of continuous beams for highway bridges. Data are input from a free field previously saved data file.

9. The program performs the complete analysis of a continuous beam for a highway bridge and reports the moments, stresses, shears, reactions, deflections, and shear connector spacings produced by the dead loads and the standard highway live loads (including the special military loading and the sidewalk live load) defined by the AASHTO "Standard Specifications for Highway Bridges" (1969, 1970 interims, and 1971).

10. The beam may be of concrete, steel, or composite concrete-steel construction. The number of spans may vary from two to eight, with any combination of lengths. The program recognizes practically any type of variation of the cross section. All possible live loading conditions are considered to insure that a maximum is obtained for each value under consideration.

11. The input information required for solution consists basically

of the loads to be considered, the properties of the material, and the actual dimensions of the beam to be analyzed. The program will perform the following operations during each computer run:

- a. Compute physical properties of the cross section along the beam.
- b. Compute elastic properties of the beam, such as stiffness and carry-over factors, etc.
- c. Solve for dead load moments, stresses, shears, etc.
- d. Develop influence lines for moments, shears, etc.
- e. Place live loads as required to select maximum moments, shears, reactions, etc.
- f. Compute maximum actual stresses and allowable fatigue stresses.
- g. Compute dead load deflections and maximum live load deflections.

12. The program has the following limitations:

- a. Intermediate hinges are not permitted.
- b. It will not analyze a beam that acts as a frame with the substructure.
- c. Load factor design is not provided for.
- d. Certain fatigue stresses are not in accordance with the 1977 AASHTO specifications.

13. The output data contain a listing of input data fully edited with headings for ease in reading and interpreting. If an error is detected by the program, processing is terminated and an "Error Message" is printed. Output is processed to a output file. This file in turn can be listed by either a remote terminal or a high-speed printer.

BRHMCP (Analysis of Multiple Column Piers for Highway Bridges)

14. This computer program was developed by the Georgia Department of Transportation for the analysis and design of substructures for highway bridges. Data are input from a free field previously saved data file.

15. The program combines the effects of the various loads that are applied to the pier according to the AASHTO specifications to determine

the critical loading conditions. The program performs the following functions:

- a. Computes the moments, shears, and reactions in the top and bottom of each column.
- b. Computes a moment envelope of the cap with reinforcing steel requirements, maximum shear with stirrup spacings, and the maximum concrete stresses in the cap.
- c. Computes the concrete and reinforcing steel stresses in the top and bottom of each column.
- d. Designs or analyzes a spread footing.

16. The program has the following limitations:

- a. Single column piers cannot be handled by the program.
- b. Load factor design required by the 1977 AASHTO specifications is not provided for.

In order to obtain a load factor design of pier columns, output for critical load conditions can be used in input for program "PCAUC." Program "PCAUC" furnishes a load factor design. It is part of the WES on-line computer programs library (WESLIB) available on the WES and Macon computers.

17. The output data contain a listing of input data fully edited with headings for ease in reading and interpreting. If an error is detected by the program, processing is terminated and an "Error Message" is printed. Output is processed to a output file. This file in turn can be listed by either a remote terminal or a high-speed printer.

BRHGEO (Geometric
Solution of Highway Bridges)

18. This computer program was developed by the Georgia Department of Transportation for the geometric solution of highway bridges. It is more commonly referred to as the skewed bridge program. Data are input from a free field previously saved data file.

19. The purpose of this program is to solve the geometrics that are required in the design, detailing, and construction of highway bridges. The program solves the geometrics by intersecting a series of longitudinal lines that run basically parallel to the bridge with a series of transverse lines that lie basically across the bridge. The

computed data (including the finished grade elevation) at each intersection point are reported as the output data.

20. The bridge may be located in one, two, or three combinations of horizontal curves and tangents. The survey line cannot be a spiral for the purpose of computing stations. Vertical alignment is limited to two vertical curves with corresponding tangents. The maximum number of longitudinal lines is 30, and the maximum number of transverse lines is 20 per span with no limitation on the number of spans.

21. The program will handle the following types of longitudinal lines:

- a. Chord.
- b. Arc.
- c. Railing.
- d. Parallel.
- e. Parallel through intersect ahead.
- f. Parallel through intersect back.
- g. Curve offset.
- h. Straight taper.
- i. Curve taper.
- j. Coordinate.

22. Transverse lines are used to represent most any type of transverse line in addition to the bent lines. The following are most often used and can be at any angle:

- a. Center-line bearings.
- b. Diaphragms.
- c. Substructure lines.
- d. Construction joints.
- e. Span division lines.
- f. Road underneath lines.

23. The output data contain a listing of the input data fully edited with numerous headings for ease in interpretation. Output is processed to an output file. This file in turn can be listed by either a remote terminal or a high-speed printer.

BRRPLG (Analysis and Rating of Plate Girder Railway Bridges)

24. This program was developed by the Association of American Railroads Technical Center for the design and rating of single span plate girder railway bridges. It was written in accordance with the 1969 AREA specifications and updated in 1975. The girders may be deck or through and may be ballasted. Data are input from a free field previously saved data file.

25. Seven common types of girder cross sections are considered. Each may have cover plates both top and bottom. Loads include a total uniform dead load for girder weight, track weight, and other dead loads, various live loads, impact, and wind. For rating purposes, the girders are analyzed for a Cooper E80 load. For analysis the following live loads may be considered:

- a. Type 1--Special box cars preceded and followed by loaded or unloaded 50-ton* box cars.
- b. Type 1A--Special box cars preceded and followed by any box cars in a train.
- c. Type 2--An entire train of special cars.
- d. Type 3--Cooper E loading.
- e. Type 4--Any general system of moving loads.
- f. Type 5--Locomotive units followed by a train of loaded 50-ton cars.
- g. Type 5A--Locomotive units followed by a train of any specified cars.

The computer output includes a listing of member sections used and a listing of dead load shears and moments. If the girder is to be rated, moments, shears, and stresses are output for an E80 loading. Train speeds of 10, 20, 30, and 40 mph are rated. If the girder is to be analyzed, the live load moments, shears, and stresses are output.

---

* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 4.

BRRTRU (Analysis of
Railway Truss Bridges)

26. This program was developed by the Association of American Railroads Technical Center for use in the design of railway truss bridges. It was written in accordance with the 1970 AREA specifications. Trusses may be of any configuration, simply supported, continuous over several supports, internally indeterminate, or contain counter diagonals. Data are input from a free field previously saved data file.

27. Maximum bar forces and reactions are computed for trusses subject to stationary or moving loads. The following live loads can be used:

a. Type 1--Special car preceded and followed by standard box cars.

b. Type 2--An entire train of special cars.

c. Type 3--Cooper E Loading.

d. Type 4--Any general system of moving loads.

e. Type 5--Locomotive units followed by loaded box cars.

28. The program has the following limitations:

a. Maximum span is 600 ft for type 3 loading.

b. Maximum span is 1000 ft for other loadings.

c. Maximum number of joints is 50.

d. Maximum number of members is 100.

e. Maximum number of panels is 25.

f. Maximum number of panels with counters is 10.

Certain restrictions are applied on trusses containing counters such as subdivided trusses, etc.

29. The computer output includes a listing of member sections with maximum axial loads due to dead, live, impact, and reversal for each member.

BRRTRR (Rating of
Railway Truss Bridges)

30. This program was developed by the Association of American Railroads Technical Center for use in computing the Cooper Rating of each bar in trusses of any configuration. This program is a companion

program to the truss analysis program (BRRTRU). All rating is in accordance with the 1975 AREA specifications, except that lateral forces are not included. Data are input from a free field previously saved data file.

31. The program has the following limitations:

- a. Maximum span is 600 ft.
- b. No compression member may have a slenderness ratio (L/r) greater than 200.
- c. Other limitations are the same as in the truss analysis program (BRRTRU).

32. The computer output includes a listing of member sections with total capacity and Cooper Ratings for each member.

The NCHRP Project

33. In 1978, the NCHRP awarded a contract to Multisystems, Incorporated, of Cambridge, Mass., to survey computer programs available in the field for various components of bridge design and to recommend the rationale and mechanics for developing an integrated bridge design program. Dr. David R. Schelling of the Department of Civil Engineering, University of Maryland, who participated in this study, prepared under contract to WES a summary of the findings of this project. A summary of this report is included below. The appendices cited in his report contain raw data from the extensive surveys made in the evaluations; they are available for loan or inspection from the CASE Project Manager at WES.

34. The program recommended by the CASE Task Group on Bridges for geometry and pier design is also recommended by the NCHRP study. While the Task Group recommended the Georgia Department of Transportation program (BRHCBA) for superstructure design, the NCHRP study recommended the Maryland, Texas, California, or Wyoming Department of Transportation programs. The Maryland program, which appears to be the most comprehensive and promising, will be available in a production mode in late 1979.

35. The objective of the initial phase of the NCHRP study was to survey and review available bridge-oriented application software. The

study included comprehensive evaluation of current practice and computer programs relating to the design of bridge and bridge-related structures. As a result of the study, a classified inventory of bridge design software was compiled which can be used for general reference. In order to accomplish this, two steps were involved. The first step was the collection (through a first mailing) of the application software documentation, its evaluation, and the utilization of the findings in establishing fundamental selection criteria. The second step was to design a questionnaire containing fundamental selection criteria in the form of a set of design features and to have the questionnaire evaluated by the user. In addition to the bridge analysis and design features, the questionnaire also included queries concerning the system software and organizational data.

36. The areas of interest were broken down into superstructure, geometry, substructures, piles, and system.

37. In the area of superstructure, documentation was received for 109 bridge superstructure programs in response to the initial mailing. The programs were evaluated using 180 feature requirements. The status (mandatory, desired, etc.) of each of the features was determined from the responses to the questionnaire. Five programs were selected for an in-depth review in Phase II, using criteria based on overall rating and generality, documentation, modularity, and current status. The programs selected for further study were:

- a. The Maryland SHA Bridge Design, Rating and Routing System, by the Maryland State Highway Administration, Department of Transportation.
- b. Design of Prestressed Concrete Girders, by the Texas State Department of Highway and Public Transportation.
- c. Analysis of Prestressed Concrete Box Girder Bridges (GIRDER PC), by the California Department of Transportation.
- d. Bridge Rating and Analysis of Structural Systems (BRASS), by the Wyoming State Highway Department.
- e. Design of Reinforced Concrete Box Girder Bridges, by the California Department of Transportation.

38. In the geometry area, documentation was received for 25 bridge geometry programs in response to the initial mailing. The programs were evaluated using 36 feature requirements. The status of each of the

features was determined from the responses to the questionnaire. Two programs were selected for an in-depth review in Phase II, using criteria based on overall rating and generality, documentation, modularity, and current status. The programs selected for further study were:

a. Geometry Solution of Highway Bridges, by the Georgia Department of Transportation.

b. BELEV, by the Kentucky Department of Transportation.

39. In the area of substructures, documentation for 45 computer programs was received in response to the initial mailing. The programs were evaluated using 146 feature requirements. The status of each of the features was again determined from the questionnaire responses. None of the programs were found to adequately satisfy the criteria based on generality, documentation, modularity, 1977 code requirements, and current status. However, three of the programs were selected for review in order to satisfy the less stringent criteria as stated in the original proposal requirements for functional modules. The three programs selected for an in-depth review were:

a. Pier Design, by the Michigan Department of Transportation.

b. Analysis of Multiple Column Piers for Highway Bridges, by the Georgia Department of Transportation.

c. Pier Design for Bridges, by Century Engineering, Inc.

40. In the area of pile group foundations, documentation for only nine computer programs was received as a result of the request made in the initial mailing. The programs were evaluated using 80 feature requirements, and the status of each of the features was again determined from the questionnaire responses. Four out of nine programs rated above average, and two of the four programs were selected for a more detailed review in Phase II. Neither of these two programs utilizes the flexure formula, and both of them employ the very general stiffness matrix analysis technique. The programs selected for further study were:

a. Analysis of Pile Group Foundations, by the Maryland State Highway Administration, Department of Transportation.

b. Analysis of Pile Group Footings, by the State of Maine, Department of Transportation.

Listing of Information File: BRIDGE

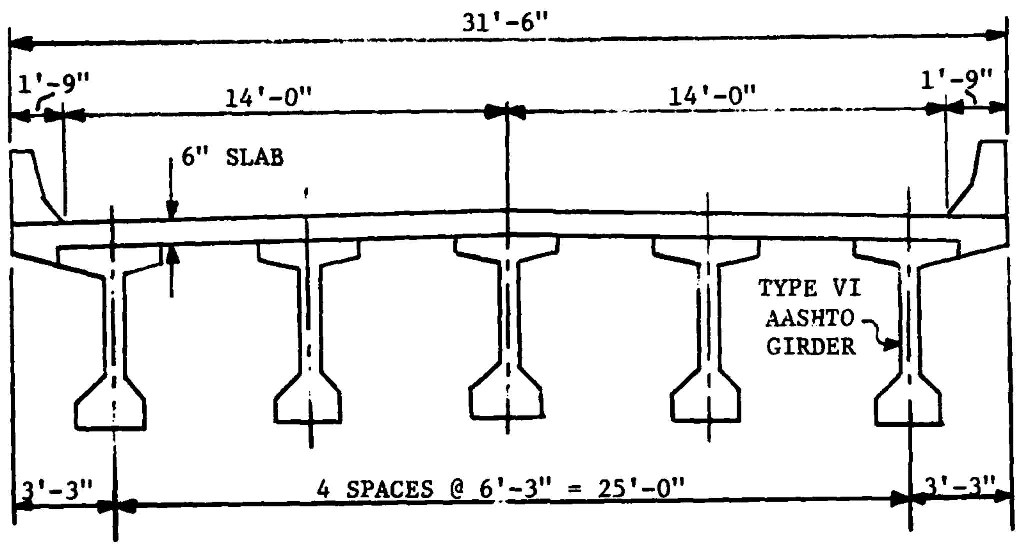
```
READY LIST
*LIST
10C   INFORMATION FILE:  BRIDGE
20C
30C   THIS INFORMATION FILE CONTAINS THE NAMES OF COMPUTER PROGRAMS
40C   RECOMMENDED BY THE CASE COMMITTEE FOR USE IN DESIGN OF
50C   HIGHWAY AND BRIDGES.
60C
70C   EACH PROGRAM IS APPLICABLE FOR THE APPLICATIONS CONTAINED
80C   IN THE FOLLOWING SCHEDULE:
90C
100C  ***************************************************************
110C  PROGRAM           CLASSIFICATION    APPLICATION
120C  NAME           HIGHWAY     RAILWAY
130C  ***************************************************************
140C
150C  BRHPSG            X           X       PRESTRESSED CONCRETE
160C
170C  BRHCBA            X                   CONTINUOUS BEAM ANALYSIS
180C                                        COMPOSITE OR NON-COMPOSITE
190C
200C  BRHMCP            X                   MULTIPLE COLUMN PIER ANALYSIS
210C
220C  BRHGEO            X                   GEOMETRIC SOLUTION OF
230C                                        HIGHWAY BRIDGES
240C
250C  BRRPLG                        X       ANALYSIS AND RATING OF PLATE
260C                                        GIRDERS AND BEAMS
270C
280C  BRRTRU                        X       ANALYSIS OF TRUSSES
290C
300C  BRRTRR                        X       RATING OF TRUSSES
310C
320C  ****************************************************************
330C
340C
350C  FOR DOCUMENTATION OF ANY OF THE ABOVE PROGRAMS
360C  CONTACT:  WAYNE JONES, COMPUTER ANALYSIS BR. WES
370C  FTS:  542-3758 OR 601-636-43111 EXT 3758

ready

*
```

Appendix A: Example Computer Runs

Example Problem for BRHPSG

SAMPLE PRESTRESSED CONCRETE

COMPOSITE HIGHWAY BRIDGE FOR BRHPSG--WITH AASHTO GIRDERS



LOADING HS20-44

SPAN = 140 ft center-to-center bearings

CONCRETE STRENGTH:

Girders at release	fci = 4000 psi
Girders at 28 days	f'c = 5000 psi
Composite slab	f'a - 3000 psi

$$\frac{E \text{ COMPOSITE SLAB}}{E \text{ GIRDER}} = 0.80$$

INPUT DATA FILE

```
*LIST FIG3

10 SAMPLE PROBLEM NØ. 1 - TYPE VI AASHTO GIRDER ORIGINAL
20 10 4 0 2 72. 140. .469 0. .569 0. 0.
30 72. 1086. 733400. 35.58 36.42 42. 5. 8.
40 .5 0. 25. .153 270. .7 .814 5.4 .93
50 5. 4. 3. .380 .19 20. 40. .62
60 4 -1 .5 .33 .25 .0 0. 0. 0. 0.
70 75. 7. .8

*
```

```
*RUN BRHPSG

IS DATA TO BE INPUT FROM
EXISTING FILE(Y OR N)  ?
=Y

NOTE# TO RETURN TO PREVIOUS QUESTION ENTER THE
      LETTER R AS A QUESTION RESPONSE.

ENTER NAME OF INPUT FILE
(MAX. 8 CHAR.)          -
=FIG3
10 SAMPLE PROBLEM NØ. 1 - TYPE VI AASHTO GIRDER ORIGINAL

ASECT          =     1086.000IN**2
SECTI          =   733400.000IN**4
YT             =       35.580IN
TB             =       36.420IN
WTS            =       42.000IN
BB             =        8.000IN
SB             =    20137.287IN**3
ST             =    20612.704IN**3
WCS            =       75.000IN
TCS            =        7.000IN
XNCS           =        0.800IN


ACMP           =     1506.000IN**2
CMPI           =  1197669.859IN**4
YTC            =       24.681IN
YBC            =       47.319IN
YTSC           =       31.681IN
STC            =    48525.602IN**3
SBC            =    25310.653IN**3
STSC           =    37803.809IN**3
QTSC           =    11836.102IN**3


MAX LL+I MOMENT      =   1516.9FT KIPS
LL+I SHEAR AT 1/4 PT =     34.1KIPS
LL+I SHEAR AT 1/3 PT =     30.2KIPS
LL+I REACTION        =     47.9KIPS


STRESSES IN EXTREME FIBERS DUE TO EXTERNAL LOADS -      KIPS PER SQ.IN.
NSEC               -          1          2          3          4
DIST               -        0.500L     0.250L     0.   L     0.   L
BEAM WT TOP        -        1.614      1.210      0.         0.
        BOTTOM     -       -1.652     -1.239      0.         0.
SDL     TOP        -        0.669      0.502      0.         0.
        BOTTOM     -       -0.685     -0.514      0.         0.
CDL     TOP        -        0.         0.         0.         0.
        BOTTOM     -        0.         0.         0.         0.
LL      TOP        -        0.375      0.288      0.         0.
        BOTTOM     -       -0.719     -0.552      0.         0.
TOTAL   TOP        -        2.658      2.000      0.         0.
        BOTTOM     -       -3.056     -2.304      0.         0.
```

COMPOSITE STRESS IN SLAB = 0.482 KIPS PER SQ.IN.
MINIMUM STRANDS = 49.462 YM = 5.400 IN. ' YE = 21.370 IN.

STRESSES DUE TO EXTERNAL LOADS AND PRESTRESS - KIPS'PER SQ. IN.

NSEC -	1	2	3	4
DIST -	0.500L	0.250L	0. L	0. L
INITIAL PRESTRESS				
TOP-	-0.777	-0.548	0.254	0.254
BOTTOM	3.274	3.039	2.219	2.219
BEAM WT + INITIAL PRESTRESS				
TOP-	0.837	0.662	0.254	0.254
BOTTOM	1.622	1.801	2.219	2.219
BEAM WT + SDL + FINAL PRESTRESS				
TOP-	1.602	1.232	0.222	0.222
BOTTOM	0.529	0.908	1.942	1.942
ALL LOADS + FINAL PRESTRESS				
TOP-	1.978	1.520	0.222	0.222
BOTTOM	-0.190	0.356	1.942	1.942

ULTIMATE MOMENT REQUIRED = 8384. FT.KIPS

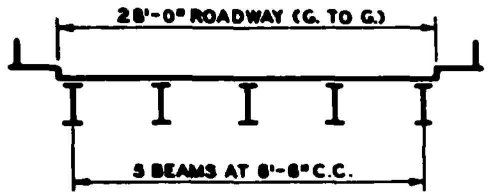
DEPTH OF COMP BLOCK MORE THAN TCS+ TTS, UMP CALC APPROXIMATE
FOR FCPC = 3.000 PSI AND 50. STRANDS
ULTIMATE MOMENT PROVIDED = 10986. FT.KIPS

```
CASE# 1
NO. OF STRANDS =   50.          YM=  5.400          YE= 21.370


NSEC   -                   1         2         3         4
DIST   -               0.500L    0.250L    0.   L    0.   L
INITIAL PRESTRESS
       TOP-           -0.785    -0.554     0.256     0.256
       BOTTOM          3.309     3.073     2.243     2.243
BEAM WT +
INITIAL PRESTRESS
       TOP-            0.828     0.656     0.256     0.256
       BOTTOM          1.658     1.834     2.243     2.243
BEAM WT + SDL +
FINAL PRESTRESS
       TOP-            1.595     1.227     0.224     0.224
       BOTTOM          0.560     0.937     1.963     1.963
ALL LOADS +
FINAL PRESTRESS
       TOP-            1.970     1.515     0.224     0.224
       BOTTOM         -0.159     0.385     1.963     1.963

DEPTH OF COMP BLOCK MORE THAN TCS+TTS,UMP CALC APPROX


ULTIMATE MOMENT REQUIRED =    8384.     FT.KIPS
ULTIMATE MOMENT PROVIDED =   10986.     FT.KIPS
AT 1/4 PT,REQUIRED STIRRUP SPACING =  31.00 IN.
AT 1/3 PT,REQUIRED STIRRUP SPACING =  31.00 IN.
DL+LL+I REACTION PER BEAM =     159.93 KIPS
ULT SHEAR STRESS BETWEEN SLAB AND BEAM AT REACTION ' =  27.155 PSI

DEFLECTIONS
BEAM WEIGHT + PRESTRESS      = -1.457 IN.
TOTAL DEAD LOAD + PRESTRESS =  0.538 IN.
LIVE LOAD + IMPACT           =  1.039 IN.

IS JOB COMPLETED? Y OR N
=Y

*
```

Example Problem for BRHCBA

82-104-82 COMPOSITE CONTINUOUS UNIT (WF WITH C.R.'S.)

INVESTIGATE FIRST INTERIOR BEAM



BRIDGE CROSS SECTION

LIVE LOAD = HS 20 and Military
A36 steel
n = 10
500,000 stress cycles

GIVEN: $W_{DL_{NC}} = 555^{LB}/_{FT}$, $W_{DL_C} = 300^{LB}/_{FT}$

$D^F_{Ve} = D^F_M$

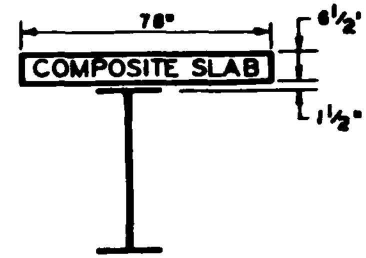
$D^F_D = 0.80$

W_{SW} = NONE

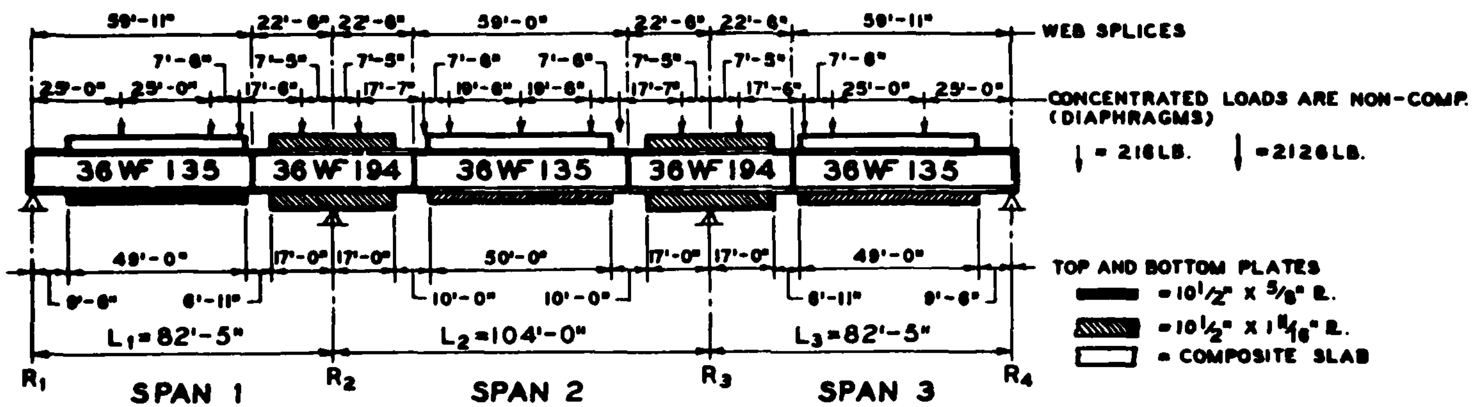
$W_G = 490.0\ ^{LB}/_{FT^3}$

$E = 29.00 \times 10^6\ ^{LB}/_{IN^2}$

$\Sigma Zr = 10.6\,(.75)^2\,(4) = 23.85^k$



COMPOSITE BEAM CROSS SECTION



INPUT DATA FILE

```
*OLD DATACBA5
READY
*LIST

11 *B01EX.5 EXAMPLE NO.5 82-104-82 COMPOSITE CONTINUOUS UNIT WF WITH COVER PLATE
12 * NOT AN ACTUAL DESIGN --- FOR CASE PROJECT - TASK GROUP BRIDGES
13 1EXAMPLE NO.53HS20000  555  300     49002900 65000 23850
14 2          08000
15 31  82417 2 2 4 3 4      1
16 400   59917  82417
17 401W36X135W36X194
18 431   65417  82417
19 432    0000  10500
20 433    0000   1688
21 441    9500  58500  65417  82417
22 442    0000  10500   0000  10500
23 443    0000    625   0000   1688
24 451    9500  58500  82417
25 452    0000  78000   0000
26 453    0000   6500   0000
27 454    0000   1500   0000
28 455    0000   0000   0000
29 461   25000  50000  57500  75000
30 462     216    216   2126    216
31 32 104000 3 3 5 3 7       1
32 400   22500  81500 104000
33 401W36X194W36X135W36X194
34 431   17000  37000 104000
35 432   10500   0000  10500
36 433    1688   0000   1688
37 441   17000  27000  77000  87000 104000
38 442   10500   0000  10500   0000  10500
39 443    1688   0000    625   0000   1688
40 451   27000  77000 104000
41 452    0000  78000   0000
42 453    0000   6500   0000
43 454    0000   1500   0000
44 455    0000   0000   0000
45 461    7417  25000  32500  52000  71500  79000  96583
46 462     216   2126    216    216    216   2126    216
47 331

ready
```

```
#RUN BRHCBA


          THE ANALYSIS OF CONTINUOUS BEAMS FOR HIGHWAY BRIDGES
          DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION

INPUT NAME OF DATA FILE. = DATACBA5

INPUT NAME OF OUTPUT FILE (1-8 CHARACTERS) OR
GIVE CARRIAGE RETURN IF OUTPUT IS TO COME TO TERMINAL. = OUTCBA

#
```

THE ANALYSIS OF CONTINUOUS BEAMS FOR HIGHWAY BRIDGES
DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION

PROB. NO. EX.5

*** 05/29/79***
10.85

EXAMPLE NO.5 82-104-82 COMPOSITE CONTINUOUS UNIT WF WITH COVER PLATE
NOT AN ACTUAL DESIGN --- FOR CASE PROJECT - TASK GROUP BRIDGES

BEAM CONSTANTS

BEAM IDENTITY	NO. OF SPANS	LIVE LOAD CLASS	BEAM TYPE	WDLNC	WDLC	WSW	WG	E	BM.SPAC.	SZR	ILO
EXAMPLE NO.5	3	HS20	COMP.ST'L.INT.	0.555	0.300	0.	490.0	29.00	6.5000	23.850	0

OPTIONAL BEAM CONSTANTS

DFM	DFVE	DFD	N	3N	LIVE LOAD USED	STRESS CYCLES	FY	FU	FC	FS
1.1818	1.1818	0.8000	10	30	TR'K LANE MIL.	500000	36.000	58.000	0.	0.

SPAN 1 INPUT DATA

M	S	L	*	NUMBER OF RANGES BM	TPL	BPL	CS	PN	PC	PWN	PWC	* BEAM SECTION TYPE
1	0	82.417		2	2	4	3	4	0	0	0	WFLG

BEAM SECTION AND LOADS

CODE	RANGE 1	RANGE 2	RANGE 3	RANGE 4	RANGE 5	RANGE 6	RANGE 7	RANGE 8	RANGE 9	RANGE 10
400	59.917	82.417								
401	W36X135	W36X194								
431	65.417	82.417								
432	0.	10.500								
433	0.	1.688								
441	9.500	58.500	65.417	82.417						
442	0.	10.500	0.	10.500						
443	0.	0.625	0.	1.688						
451	9.500	58.500	82.417							

452	0.	78.000	0.	
453	0.	6.500	0.	
454	0.	1.500	0.	
455	0.	0.	0.	
461	25.000	50.000	57.500	75.000
462	0.216	0.216	2.126	0.216

EXAMPLE NO.5

SPAN 2 INPUT DATA

M	S	L	* BM	TPL	BPL	CS	PN	PC	PWN	PWC	* BEAM SECTION TYPE
			NUMBER OF RANGES								
2	0	104.000	3	3	5	3	7	0	0	0	WFLG

BEAM SECTION AND LOADS

CODE	RANGE 1	RANGE 2	RANGE 3	RANGE 4	RANGE 5	RANGE 6	RANGE 7	RANGE 8	RANGE 9	RANGE 10
400	22.500	81.500	104.000							
401	W36X194	W36X135	W36X194							
431	17.000	87.000	104.000							
432	10.500	0.	10.500							
433	1.688	0.	1.688							
441	17.000	27.000	77.000	87.000	104.000					
442	10.500	0.	10.500	0.	10.500					
443	1.688	0.	0.625	0.	1.688					
451	27.000	77.000	104.000							
452	0.	78.000	0.							
453	0.	6.500	0.							
454	0.	1.500	0.							
455	0.	0.	0.							
461	7.417	25.000	32.500	52.000	71.500	79.000	96.583			
462	0.216	2.126	0.216	0.216	0.216	2.126	0.216			

SPAN 3 INPUT DATA SAME AS SPAN 1 INPUT DATA

EXAMPLE NO.5

BEAM SECTION PROPERTIES AT SPAN TWENTIETH POINTS
NON-COMPOSITE

S.PT	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I	S.PT	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I

12/06/79 FILE - OUTCBA 12:35 PAGE 3

1.00	35.55	7820.0	439.9	439.9	0.	0.	1.05	35.55	7820.0	439.9	439.9	0.	0.
1.10	35.55	7820.0	439.9	439.9	0.	0.	1.15	35.55	9663.3	610.1	475.2	0.	0.
1.20	35.55	9663.3	610.1	475.2	0.	0.	1.25	35.55	9663.3	610.1	475.2	0.	0.
1.30	35.55	9663.3	610.1	475.2	0.	0.	1.35	35.55	9663.3	610.1	475.2	0.	0.
1.40	35.55	9663.3	610.1	475.2	0.	0.	1.45	35.55	9663.3	610.1	475.2	0.	0.
1.50	35.55	9663.3	610.1	475.2	0.	0.	1.55	35.55	9663.3	610.1	475.2	0.	0.
1.60	35.55	9663.3	610.1	475.2	0.	0.	1.65	35.55	9663.3	610.1	475.2	0.	0.
1.70	35.55	9663.3	610.1	475.2	0.	0.	1.75	36.48	12100.0	663.4	663.4	0.	0.
1.80	36.48	25018.5	1255.4	1255.4	0.	0.	1.85	36.48	25018.5	1255.4	1255.4	0.	0.
1.90	36.48	25018.5	1255.4	1255.4	0.	0.	1.95	36.48	25018.5	1255.4	1255.4	0.	0.
2.00	36.48	25018.5	1255.4	1255.4	0.	0.							
							2.05	36.48	25018.5	1255.4	1255.4	0.	0.
2.10	36.48	25018.5	1255.4	1255.4	0.	0.	2.15	36.48	25018.5	1255.4	1255.4	0.	0.
2.20	36.48	12100.0	663.4	663.4	0.	0.	2.25	35.55	7820.0	439.9	439.9	0.	0.
2.30	35.55	9663.3	610.1	475.2	0.	0.	2.35	35.55	9663.3	610.1	475.2	0.	0.
2.40	35.55	9663.3	610.1	475.2	0.	0.	2.45	35.55	9663.3	610.1	475.2	0.	0.
2.50	35.55	9663.3	610.1	475.2	0.	0.	2.55	35.55	9663.3	610.1	475.2	0.	0.
2.60	35.55	9663.3	610.1	475.2	0.	0.	2.65	35.55	9663.3	610.1	475.2	0.	0.
2.70	35.55	9663.3	610.1	475.2	0.	0.	2.75	35.55	7820.0	439.9	439.9	0.	0.
2.80	36.48	12100.0	663.4	663.4	0.	0.	2.85	36.48	25018.5	1255.4	1255.4	0.	0.
2.90	36.48	25018.5	1255.4	1255.4	0.	0.	2.95	36.48	25018.5	1255.4	1255.4	0.	0.
3.00	36.48	25018.5	1255.4	1255.4	0.	0.							
							3.05	36.48	25018.5	1255.4	1255.4	0.	0.
3.10	36.48	25018.5	1255.4	1255.4	0.	0.	3.15	36.48	25018.5	1255.4	1255.4	0.	0.
3.20	36.48	25018.5	1255.4	1255.4	0.	0.	3.25	36.48	12100.0	663.4	663.4	0.	0.
3.30	35.55	9663.3	610.1	475.2	0.	0.	3.35	35.55	9663.3	610.1	475.2	0.	0.
3.40	35.55	9663.3	610.1	475.2	0.	0.	3.45	35.55	9663.3	610.1	475.2	0.	0.
3.50	35.55	9663.3	610.1	475.2	0.	0.	3.55	35.55	9663.3	610.1	475.2	0.	0.
3.60	35.55	9663.3	610.1	475.2	0.	0.	3.65	35.55	9663.3	610.1	475.2	0.	0.
3.70	35.55	9663.3	610.1	475.2	0.	0.	3.75	35.55	9663.3	610.1	475.2	0.	0.
3.80	35.55	9663.3	610.1	475.2	0.	0.	3.85	35.55	9663.3	610.1	475.2	0.	0.
3.90	35.55	7820.0	439.9	439.9	0.	0.	3.95	35.55	7820.0	439.9	439.9	0.	0.
4.00	35.55	7820.0	439.9	439.9	0.	0.							

SPAN PROPERTIES

SPAN	DL	KL	KLM	CLR	CLRM	CRLM	CRL	KRM	KR	DR
1	1.000000	0.004933	0.004031	0.683730	0.328931	0.	0.440870	0.005344	0.007650	0.518917
2	0.481083	0.006223	0.004955	0.615546	0.357201	0.357201	0.615546	0.004955	0.006223	0.481083
3	0.518917	0.007650	0.005344	0.440870	0.	0.328931	0.683730	0.004031	0.004933	1.000000

EXAMPLE NO.5

BEAM SECTION PROPERTIES AT SPAN TWENTIETH POINTS
COMPOSITE N = 30

S.PT	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I	S.PT	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I

1.00	35.55	7820.0	439.9	439.9	0.	0.	1.05	35.55	7820.0	439.9	439.9	0.	0.
1.10	35.55	7820.0	439.9	439.9	0.	0.	1.15	35.55	17516.5	777.1	1284.8	809.7	0.017737
1.20	35.55	17516.5	777.1	1284.8	809.7	0.017737	1.25	35.55	17516.5	777.1	1284.8	809.7	0.017737
1.30	35.55	17516.5	777.1	1284.8	809.7	0.017737	1.35	35.55	17516.5	777.1	1284.8	809.7	0.017737
1.40	35.55	17516.5	777.1	1284.8	809.7	0.017737	1.45	35.55	17516.5	777.1	1284.8	809.7	0.017737
1.50	35.55	17516.5	777.1	1284.8	809.7	0.017737	1.55	35.55	17516.5	777.1	1284.8	809.7	0.017737
1.60	35.55	17516.5	777.1	1284.8	809.7	0.017737	1.65	35.55	17516.5	777.1	1284.8	809.7	0.017737
1.70	35.55	17516.5	777.1	1284.8	809.7	0.017737	1.75	36.48	12100.0	663.4	663.4	0.	0.
1.80	36.48	25018.5	1255.4	1255.4	0.	0.	1.85	36.48	25018.5	1255.4	1255.4	0.	0.
1.90	36.48	25018.5	1255.4	1255.4	0.	0.	1.95	36.48	25018.5	1255.4	1255.4	0.	0.
2.00	36.48	25018.5	1255.4	1255.4	0.	0.							
							2.05	36.48	25018.5	1255.4	1255.4	0.	0.
2.10	36.48	25018.5	1255.4	1255.4	0.	0.	2.15	36.48	25018.5	1255.4	1255.4	0.	0.
2.20	36.48	12100.0	663.4	663.4	0.	0.	2.25	35.55	7820.0	439.9	439.9	0.	0.
2.30	35.55	17516.5	777.1	1284.8	809.7	0.017737	2.35	35.55	17516.5	777.1	1284.8	809.7	0.017737
2.40	35.55	17516.5	777.1	1284.8	809.7	0.017737	2.45	35.55	17516.5	777.1	1284.8	809.7	0.017737
2.50	35.55	17516.5	777.1	1284.8	809.7	0.017737	2.55	35.55	17516.5	777.1	1284.8	809.7	0.017737
2.60	35.55	17516.5	777.1	1284.8	809.7	0.017737	2.65	35.55	17516.5	777.1	1284.8	809.7	0.017737
2.70	35.55	17516.5	777.1	1284.8	809.7	0.017737	2.75	35.55	7820.0	439.9	439.9	0.	0.
2.80	36.48	12100.0	663.4	663.4	0.	0.	2.85	36.48	25018.5	1255.4	1255.4	0.	0.
2.90	36.48	25018.5	1255.4	1255.4	0.	0.	2.95	36.48	25018.5	1255.4	1255.4	0.	0.
3.00	36.48	25018.5	1255.4	1255.4	0.	0.							
							3.05	36.48	25018.5	1255.4	1255.4	0.	0.
3.10	36.48	25018.5	1255.4	1255.4	0.	0.	3.15	36.48	25018.5	1255.4	1255.4	0.	0.
3.20	36.48	25018.5	1255.4	1255.4	0.	0.	3.25	36.48	12100.0	663.4	663.4	0.	0.
3.30	35.55	17516.5	777.1	1284.8	809.7	0.017737	3.35	35.55	17516.5	777.1	1284.8	809.7	0.017737
3.40	35.55	17516.5	777.1	1284.8	809.7	0.017737	3.45	35.55	17516.5	777.1	1284.8	809.7	0.017737
3.50	35.55	17516.5	777.1	1284.8	809.7	0.017737	3.55	35.55	17516.5	777.1	1284.8	809.7	0.017737
3.60	35.55	17516.5	777.1	1284.8	809.7	0.017737	3.65	35.55	17516.5	777.1	1284.8	809.7	0.017737
3.70	35.55	17516.5	777.1	1284.8	809.7	0.017737	3.75	35.55	17516.5	777.1	1284.8	809.7	0.017737
3.80	35.55	17516.5	777.1	1284.8	809.7	0.017737	3.85	35.55	17516.5	777.1	1284.8	809.7	0.017737
3.90	35.55	7820.0	439.9	439.9	0.	0.	3.95	35.55	7820.0	439.9	439.9	0.	0.
4.00	35.55	7820.0	439.9	439.9	0.	0.							

SPAN PROPERTIES

SPAN	DL	KL	KLM	CLR	CLRM	CRLM	CRL	KRM	KR	DR
1	1.000000	0.006230	0.005404	0.565487	0.263713	0.	0.393794	0.006954	0.008946	0.533654
2	0.466346	0.007142	0.006077	0.542447	0.314500	0.314500	0.542447	0.006077	0.007142	0.466346
3	0.533654	0.008946	0.006954	0.393794	0.	0.263713	0.565487	0.005404	0.006230	1.000000

EXAMPLE NO.5

BEAM SECTION PROPERTIES AT SPAN TWENTIETH POINTS
COMPOSITE N = 10

S.PT	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I
1.00	35.55	7820.0	439.9	439.9	0.	0.
1.10	35.55	7820.0	439.9	439.9	0.	0.
1.20	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.30	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.40	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.50	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.60	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.70	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.80	36.48	25018.5	1255.4	1255.4	0.	0.
1.90	36.48	25018.5	1255.4	1255.4	0.	0.
2.00	36.48	25018.5	1255.4	1255.4	0.	0.
2.10	36.48	25018.5	1255.4	1255.4	0.	0.
2.20	36.48	12100.0	663.4	663.4	0.	0.
2.30	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.40	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.50	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.60	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.70	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.80	36.48	12100.0	663.4	663.4	0.	0.
2.90	36.48	25018.5	1255.4	1255.4	0.	0.
3.00	36.48	25018.5	1255.4	1255.4	0.	0.
3.10	36.48	25018.5	1255.4	1255.4	0.	0.
3.20	36.48	25018.5	1255.4	1255.4	0.	0.
3.30	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.40	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.50	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.60	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.70	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.80	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.90	35.55	7820.0	439.9	439.9	0.	0.
4.00	35.55	7820.0	439.9	439.9	0.	0.

S.PT	D.WEB	I	SM.BS	SM.TS	SM.TC	Q/I
1.05	35.55	7820.0	439.9	439.9	0.	0.
1.15	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.25	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.35	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.45	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.55	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.65	35.55	25080.9	866.6	3468.0	1646.6	0.024221
1.75	36.48	12100.0	663.4	663.4	0.	0.
1.85	36.48	25018.5	1255.4	1255.4	0.	0.
1.95	36.48	25018.5	1255.4	1255.4	0.	0.
2.05	36.48	25018.5	1255.4	1255.4	0.	0.
2.15	36.48	25018.5	1255.4	1255.4	0.	0.
2.25	35.55	7820.0	439.9	439.9	0.	0.
2.35	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.45	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.55	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.65	35.55	25080.9	866.6	3468.0	1646.6	0.024221
2.75	35.55	7820.0	439.9	439.9	0.	0.
2.85	36.48	25018.5	1255.4	1255.4	0.	0.
2.95	36.48	25018.5	1255.4	1255.4	0.	0.
3.05	36.48	25018.5	1255.4	1255.4	0.	0.
3.15	36.48	25018.5	1255.4	1255.4	0.	0.
3.25	36.48	12100.0	663.4	663.4	0.	0.
3.35	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.45	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.55	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.65	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.75	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.85	35.55	25080.9	866.6	3468.0	1646.6	0.024221
3.95	35.55	7820.0	439.9	439.9	0.	0.

SPAN PROPERTIES

SPAN	DL	KL	KLM	CLR	CLRM	CRLM	CRL	KRM	KR	DR
1	1.000000	0.006976	0.006223	0.501201	0.230290	0.	0.364895	0.007829	0.009582	0.540524
2	0.459476	0.007601	0.006655	0.502574	0 291240	0.291240	0.502574	0.006655	0.007601	0.459476
3	0.540524	0.009582	0.007829	0.364895	0.	0.230290	0.501201	0.006223	0.006976	1.000000

EXAMPLE NO.5

MOMENTS(KIP-FEET) AT SPAN TENTH AND MISC. POINTS

* NON-COMPOSITE DEAD LOADS * COMPOSITE DEAD LOADS * LIVE LOADS * TOTALS

S.P	BEAM	PN	WDLNC	WPN	TOT.NC *	PC	WDLC	WPC	TOT.C *	SWK.+	SWK.-	LL+I +	LL+I - *	MAX.+	MAX.-
1.1	31.2	2.0	111.5	0.	144.7	0.	63.3	0.	63.3	0.	0.	323.5 T	-48.3 T	531.4	159.7
1.2	52.6	4.0	185.2	0.	241.8	0.	106.2	0.	106.2	0.	0.	545.2 T	-96.5 T	893.3	251.5
1.3	63.4	6.0	221.3	0.	290.6	0.	128.7	0.	128.7	0.	0.	670.5 T	-144.8 T	1089.9	274.5
1.4	63.4	6.2	219.6	0.	289.3	0.	130.9	0.	130.9	0.	0.	727.5 T	-193.1 T	1147.7	227.1
1.5	52.7	6.5	180.3	0.	239.4	0.	112.7	0.	112.7	0.	0.	715.6 T	-241.3 T	1067.7	110.7
1.6	31.3	6.7	103.3	0.	141.2	0.	74.1	0.	74.1	0.	0.	646.1 T	-289.6 T	861.4	-74.4
1.7	-0.9	4.8	-11.5	0.	-7.5	0.	15.1	0.	15.1	0.	0.	506.6 T	-337.9 T	514.1	-330.4
1.8	-44.0	-14.3	-163.9	0.	-222.2	0.	-64.3	0.	-64.3	0.	0.	318.4 T	-386.2 T	31.9	-672.7
1.9	-105.2	-33.4	-354.0	0.	-492.6	0.	-164.0	0.	-164.0	0.	0.	127.8 M	-440.4 L	-528.8	-1097.0
2.0	-187.7	-54.1	-581.9	0.	-823.6	0.	-284.1	0.	-284.1	0.	0.	106.9 T	-688.0 L	-1000.9	-1795.8
2.1	-91.0	-27.0	-311.7	0.	-429.7	0.	-138.1	0.	-138.1	0.	0.	133.9 M	-367.0 L	-433.9	-934.8
2.2	-27.4	-1.5	-101.6	0.	-130.5	0.	-24.5	0.	-24.5	0.	0.	343.0 T	-272.3 T	188.0	-427.3
2.3	14.9	10.8	48.4	0.	74.1	0.	56.6	0.	56.6	0.	0.	554.7 T	-224.9 T	685.4	-94.2
2.4	40.5	12.2	138.5	0.	191.2	0.	105.2	0.	105.2	0.	0.	686.4 T	-198.2 L	982.8	98.2
2.5	49.0	13.3	168.5	0.	230.8	0.	121.5	0.	121.5	0.	0.	720.9 T	-198.2 L	1073.2	154.1
2.6	40.5	12.2	138.5	0.	191.2	0.	105.2	0.	105.2	0.	0.	686.4 T	-198.2 L	982.8	98.2
2.7	14.9	10.8	48.4	0.	74.1	0.	56.6	0.	56.6	0.	0.	554.7 T	-224.9 T	685.4	-94.2
2.8	-27.4	-1.5	-101.6	0.	-130.5	0.	-24.5	0.	-24.5	0.	0.	343.0 T	-272.3 T	188.0	-427.3
2.9	-91.0	-27.0	-311.7	0.	-429.7	0.	-138.1	0.	-138.1	0.	0.	133.9 M	-367.0 L	-433.9	-934.8
3.0	-187.7	-54.1	-581.9	0.	-823.6	0.	-284.1	0.	-284.1	0.	0.	106.9 T	-688.0 L	-1000.9	-1795.8
3.1	-105.2	-33.4	-354.0	0.	-492.6	0.	-164.0	0.	-164.0	0.	0.	127.8 M	-440.4 L	-528.8	-1097.0
3.2	-44.0	-14.3	-163.9	0.	-222.2	0.	-64.3	0.	-64.3	0.	0.	318.4 T	-386.2 T	31.9	-672.7
3.3	-0.9	4.8	-11.5	0.	-7.5	0.	15.1	0.	15.1	0.	0.	506.6 T	-337.9 T	514.1	-330.4
3.4	31.3	6.7	103.3	0.	141.2	0.	74.1	0.	74.1	0.	0.	646.1 T	-289.6 T	861.4	-74.4
3.5	52.7	6.5	180.3	0.	239.4	0.	112.7	0.	112.7	0.	0.	715.6 T	-241.3 T	1067.7	110.7
3.6	63.4	6.2	219.6	0.	289.3	0.	130.9	0.	130.9	0.	0.	727.5 T	-193.1 T	1147.7	227.1
3.7	63.4	6.0	221.3	0.	290.6	0.	128.7	0.	128.7	0.	0.	670.5 T	-144.8 T	1089.9	274.5
3.8	52.6	4.0	185.2	0.	241.8	0.	106.2	0.	106.2	0.	0.	545.2 T	-96.5 T	893.3	251.5
3.9	31.2	2.0	111.5	0.	144.7	0.	63.3	0.	63.3	0.	0.	323.5 T	-48.3 T	531.4	159.7
1.115					162.7				71.2	0.	0.	363.2	-55.6	597.0	178.2
1.710					-27.1				8.2	0.	0.	483.7	-341.8	464.8	-360.7
1.727					-60.2				-4.3	0.	0.	455.1	-350.2	390.6	-414.8
1.794					-205.6				-58.7	0.	0.	337.0	-383.8	72.7	-648.2
2.163					-228.8				-62.3	0.	0.	248.7	-283.8	-42.5	-574.9
2.216					-91.5				-9.1	0.	0.	388.6	-264.9	288.0	-365.5
2.260					2.6				27.7	0.	0.	471.5	-239.1	501.8	-208.8
2.740					2.6				27.7	0.	0.	471.5	-239.1	501.8	-208.8
2.784					-91.5				-9.1	0.	0.	388.6	-264.9	288.0	-365.5
2.837					-228.8				-62.3	0.	0.	248.7	-283.8	-42.5	-574.9
3.206					-205.6				-58.7	0.	0.	337.0	-383.8	72.7	-648.2

3.273	-60.2	-4.3	0.	0.	455.1	-350.2	390.6	-414.8
3.290	-27.1	8.2	0.	0.	483.7	-341.8	464.8	-360.7
3.885	162.7	71.2	0.	0.	363.2	-55.6	597.0	178.2

EXAMPLE NO.5

STRESSES AT SPAN TENTH AND MISCELLANEOUS POINTS

	* ACTUAL STRESSES(PSI)									* ALLOWABLE FATIGUE STRESSES(PSI)									
	TOTAL DEAD LOAD			D.L. + L.L. POS.			D.L. + L.L. NEG.			* BASE METAL		BASE M. ADJ.		BASE M. ADJ.		BASE M. ADJ.		FLANGE
	TOP	TOP	BOT.	TOP	TOP	BOT.	TOP	TOP	BOT.	TOP	BOT.	FILLET WELD		CON.FIL.WELD		BUTT WELD		W STUD
S.PT.	CONC.	STEEL	STEEL	CONC.	STEEL	STEEL	CONC.	STEEL	STEEL	STEEL	STEEL	TOP S	BOT.S	TOP S	BOT.S	TOP S	BOT.S	TOP S
1.100	0	5672	-5672	0	14494	-14494	0	4355	-4355	20000	20000	17869	17869	20000	20000	20000	-20000	20000
1.200	52	7098	-6396	449	8985	-13947	-17	6764	-5060	20000	20000	20000	19617	20000	20000	20000	-20000	20000
1.300	63	8541	-7704	552	10861	-16989	-41	8040	-5699	20000	20000	20000	18809	20000	20000	20000	-20000	20000
1.400	64	8527	-7710	594	11044	-17785	-76	7859	-5037	20000	20000	20000	17439	20000	20000	20000	-20000	20000
1.500	55	7098	-6449	577	9574	-16358	-120	6263	-3107	20000	20000	20000	15430	20000	20000	20000	-19495	20000
1.600	36	4257	-3920	507	6492	-12868	-174	3254	89	20000	20000	20000	12413	20000	20000	20000	-17125	20000
1.700	7	-49	-84	376	1703	-7099	-238	-1218	4594	20000	20000	7286	7588	16030	16695	12236	-12274	11262
1.800	0	-2738	2738	0	305	-305	0	-6429	6429	20000	20000	11933	11933	20000	20000	-16708	19192	20000
1.900	0	-6275	6275	0	-5054	5054	0	-10485	10485	20000	20000	20000	20000	20000	20000	-20000	20000	20000
2.000	0	-10588	10588	0	-9566	9566	0	-17164	17164	20000	20000	20000	20000	20000	20000	-20000	20000	20000
2.100	0	-5427	5427	0	-4147	4147	0	-8935	8935	20000	20000	20000	20000	20000	20000	-20000	20000	20000
2.200	0	-2804	2804	0	3400	-3400	0	-7729	7729	20000	20000	8681	8681	19098	19098	-13514	14387	20000
2.300	27	2399	-2331	432	4319	-10012	-135	1621	782	20000	20000	20000	11593	20000	20000	20000	-16405	20000
2.400	51	5810	-5385	552	8185	-14890	-92	5124	-2640	20000	20000	20000	15194	20000	20000	20000	-19324	20000
2.500	60	6963	-6416	585	9457	-16398	-84	6277	-3671	20000	20000	20000	16105	20000	20000	20000	-19972	20000
2.600	51	5810	-5385	552	8185	-14890	-92	5124	-2640	20000	20000	20000	15194	20000	20000	20000	-19324	20000
2.700	27	2399	-2331	432	4319	-10012	-135	1621	782	20000	20000	20000	11593	20000	20000	20000	-16405	20000
2.800	0	-2804	2804	0	3400	-3400	0	-7729	7729	20000	20000	8681	8681	19098	19098	-13514	14387	20000
2.900	0	-5427	5427	0	-4147	4147	0	-8935	8935	20000	20000	20000	20000	20000	20000	-20000	20000	20000
3.000	0	-10588	10588	0	-9566	9566	0	-17164	17164	20000	20000	20000	20000	20000	20000	-20000	20000	20000
3.100	0	-6275	6275	0	-5054	5054	0	-10485	10485	20000	20000	20000	20000	20000	20000	-20000	20000	20000
3.200	0	-2738	2738	0	305	-305	0	-6429	6429	20000	20000	11933	11933	20000	20000	-16708	19192	20000
3.300	7	-49	-84	376	1703	-7099	-238	-1218	4594	20000	20000	7286	7588	16030	16695	12236	-12274	11262
3.400	36	4257	-3920	507	6492	-12868	-174	3254	89	20000	20000	20000	12413	20000	20000	20000	-17125	20000
3.500	55	7098	-6449	577	9574	-16358	-120	6263	-3107	20000	20000	20000	15430	20000	20000	20000	-19495	20000
3.600	64	8527	-7710	594	11044	-17785	-76	7859	-5037	20000	20000	20000	17439	20000	20000	20000	-20000	20000
3.700	63	8541	-7704	552	10861	-16989	-41	8040	-5699	20000	20000	20000	18809	20000	20000	20000	-20000	20000
3.800	52	7098	-6396	449	8985	-13947	-17	6764	-5060	20000	20000	20000	19617	20000	20000	20000	-20000	20000
3.900	0	5672	-5672	0	14494	-14494	0	4355	-4355	20000	20000	17869	17869	20000	20000	20000	-20000	20000

EXAMPLE NO.5 STRESSES AT SPAN TENTH AND MISCELLANEOUS POINTS

	* ACTUAL STRESSES(PSI)									* ALLOWABLE FATIGUE STRESSES(PSI)								
	TOTAL DEAD LOAD			D.L. + L.L. POS.			D.L. + L.L. NEG.			* BASE METAL		BASE M. ADJ.		BASE M. ADJ.		BASE M. ADJ.		FLANGE
	TOP	TOP	BOT.	TOP	TOP	BOT.	TOP	TOP	BOT.	TOP	BOT.	FILLET WELD		CON.FIL.WELD		BUTT WELD		W STUD
S.PT.	CONC.	STEEL	STEEL	CONC.	STEEL	STEEL	CONC.	STEEL	STEEL	STEEL	STEEL	TOP S	BOT.S	TOP S	BOT.S	TOP S	BOT.S	TOP S
1.115	0	6378	-6378	0	16284	-16284	0	4860	-4860	20000	20000	17818	17818	20000	20000	20000	-20000	20000
1.115	35	4773	-4299	299	6029	-9328	-5	4580	-3528	20000	20000	20000	20000	20000	20000	20000	-20000	20000
1.710	4	-608	407	356	1064	-6290	-245	-1791	5139	20000	19812	7839	6879	17246	15134	-12567	-11416	11900
1.710	0	-516	516	0	12676	-12676	0	-9838	9838	20000	20000	7037	7037	15483	15483	11846	-11612	20000
1.727	0	-1760	1760	0	10653	-10653	0	-11313	11313	18540	18540	6437	6437	14163	14163	-10859	10898	20000
1.727	0	-1167	1167	0	7065	-7065	0	-7502	7502	18540	18540	6437	6437	14163	14163	-10859	10898	20000
1.794	0	-4781	4781	0	1314	-1314	0	-11724	11724	20000	20000	11239	11239	20000	20000	-16081	18190	20000
1.794	0	-2526	2526	0	694	-694	0	-6195	6195	20000	20000	11239	11239	20000	20000	-16081	18190	20000
2.163	0	-2782	2782	0	-405	405	0	-5495	5495	20000	20000	13496	13496	20000	20000	-18025	20000	20000
2.163	0	-5266	5266	0	-767	767	0	-10399	10399	20000	20000	13496	13496	20000	20000	-18025	20000	20000
2.216	0	-1819	1819	0	5209	-5209	0	-6611	6611	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.216	0	-2744	2744	0	7855	-7855	0	-9969	9969	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.260	0	828	-828	0	13688	-13688	0	-5694	5694	20000	20000	8827	8827	19420	19420	14609	-13673	20000
2.260	13	325	-479	357	1956	-7008	-160	-501	2831	20000	20000	9948	8903	20000	19586	16294	-13754	14142
2.740	13	325	-479	357	1956	-7008	-160	-501	2831	20000	20000	9948	8903	20000	19586	16294	-13754	14142
2.740	0	828	-828	0	13688	-13688	0	-5694	5694	20000	20000	8827	8827	19420	19420	14609	-13673	20000
2.784	0	-2744	2744	0	7855	-7855	0	-9969	9969	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.784	0	-1819	1819	0	5209	-5209	0	-6611	6611	20000	20000	6991	6991	15380	15380	-11554	11773	20000
2.837	0	-5266	5266	0	-767	767	0	-10399	10399	20000	20000	13496	13496	20000	20000	-18025	20000	20000
2.837	0	-2782	2782	0	-405	405	0	-5495	5495	20000	20000	13496.	13496	20000	20000	-18025	20000	20000
3.206	0	-2526	2526	0	694	-694	0	-6195	6195	20000	20000	11239	11239	20000	20000	-16081	18190	20000
3.206	0	-4781	4781	0	1314	-1314	0	-11724	11724	20000	20000	11239	11239	20000	20000	-16081	18190	20000
3.273	0	-1167	1167	0	7065	-7065	0	-7502	7502	18540	18540	6437	6437	14163	14163	-10859	10898	20000
3.273	0	-1760	1760	0	10653	-10653	0	-11313	11313	18540	18540	6437	6437	14163	14163	-10859	10898	20000
3.290	0	-516	516	0	12676	-12676	0	-9838	9838	20000	20000	7037	7037	15483	15483	11846	-11612	20000
3.290	4	-608	407	356	1064	-6290	-245	-1791	5139	20000	19812	7839	6879	17246	15134	-12567	-11416	11900
3.885	35	4773	-4299	299	6029	-9328	-5	4580	-3528	20000	20000	20000	20000	20000	20000	20000	-20000	20000
3.885	0	6378	-6378	0	16284	-16284	0	4860	-4860	20000	20000	17818	17818	20000	20000	20000	-20000	20000

EXAMPLE NO.5 SHEARS(KIPS AND SHEAR CONNECTOR SPACINGS(INCHES) AT SPAN TENTH POINTS AND REACTIONS(KIPS)

	DEAD LOADS						*	LIVE LOADS			* MAXIMUM	LL SHEAR	SHEAR
S.PT	BEAM	PN	WN	WPN	TOT.C	TOT.DL	* SWK.+	SWK.-	LL+I +	LL+I -	* V OR R	RANGE	CON.SP.
1.00	4.345	0.242	15.811	0.	8.915	29.313	0.	0.	45.569 T	-6.194 T	74.881	51.763	0.
1.10	3.229	0.242	11.237	0.	6.443	21.150	0.	0.	39.562 T	-6.332 L	60.712	45.895	0.

1.20	1.952	0.242	6.662	0.	3.970	12.826	0.	0.	33.632 T	-9.474 L	46.458	43.106	22.84
1.30	0.652	0.242	2.088	0.	1.498	4.479	0.	0.	27.808 T	-13.053 L	32.287	40.862	24.00
1.40	-0.649	0.026	-2.486	0.	-0.975	-4.084	0.	0.	22.153 T	-18.980 T	-23.064	41.133	23.93
1.50	-1.949	0.026	-7.060	0.	-3.447	-12.431	0.	0.	16.755 T	-25.306 T	-37.737	42.062	23.41
1.60	-3.249	0.026	-11.634	0.	-5.920	-20.778	0.	0.	11.604 T	-31.064 T	-51.842	42.668	23.07
1.70	-4.549	-2.316	-16.208	0.	-8.393	-31.466	0.	0.	7.195 T	-36.411 T	-67.877	43.606	22.58
1.80	-6.118	-2.316	-20.782	0.	-10.865	-40.082	0.	0.	4.123 M	-41.177 T	-81.258	45.300	0.
1.90	-8.716	-2.316	-25.357	0.	-13.338	-49.726	0.	0.	1.991 L	-45.337 T	-95.063	47.327	0.
2.00	-11.314	-2.532	-29.931	0.	-15.810	-59.587	0.	0.	0.684 L	-48.805 T	-108.392	49.489	0.
R1-2	22.255	5.198	58.791	0.	31.410	117.654	0.		70.146 L		187.800		
2.00	10.941	2.666	28.860	0.	15.600	58.067	0.	0.	48.341 T	-4.820 T	106.408	53.161	0.
2.10	7.662	2.450	23.088	0.	12.480	45.680	0.	0.	44.371 T	-4.820 T	90.052	49.191	0.
2.20	4.854	2.450	17.316	0.	9.360	33.980	0.	0.	39.459 T	-6.159 L	73.439	45.618	0.
2.30	3.281	0.324	11.544	0.	6.240	21.389	0.	0.	33.745 T	-9.479 T	55.134	43.224	22.78
2.40	1.641	0.108	5.772	0.	3.120	10.641	0.	0.	27.633 T	-15.267 T	38.273	42.900	22.95
2.50	0.000	0.108	0.000	0.	0.000	0.108	0.	0.	21.392 T	-21.392 T	21.500	42.784	23.01
2.60	-1.641	-0.108	-5.772	0.	-3.120	-10.641	0.	0.	15.267 T	-27.633 T	-38.273	42.900	22.95
2.70	-3.281	-0.324	-11.544	0.	-6.240	-21.389	0.	0.	9.479 T	-33.745 T	-55.134	43.224	22.78
2.80	-4.854	-2.450	-17.316	0.	-9.360	-33.980	0.	0.	6.159 L	-39.459 T	-73.439	45.618	0.
2.90	-7.662	-2.450	-23.088	0.	-12.480	-45.680	0.	0.	4.820 T	-44.371 T	-90.052	49.191	0.
3.00	-10.941	-2.666	-28.860	0.	-15.600	-58.067	0.	0.	4.820 T	-48.341 T	-106.408	53.161	0.
R2-3	22.255	5.198	58.791	0.	31.410	117.654	0.		70.146 L		187.800		
3.00	11.314	2.532	29.931	0.	15.810	59.587	0.	0.	48.805 T	-0.684 L	108.392	49.489	0.
3.10	8.716	2.316	25.357	0.	13.338	49.726	0.	0.	45.337 T	-1.991 L	95.063	47.327	0.
3.20	6.118	2.316	20.782	0.	10.865	40.082	0.	0.	41.177 T	-4.123 M	81.258	45.300	0.
3.30	4.549	2.316	16.208	0.	8.393	31.466	0.	0.	36.411 T	-7.195 T	67.877	43.606	22.58
3.40	3.249	-0.026	11.634	0.	5.920	20.778	0.	0.	31.064 T	-11.604 T	51.842	42.668	23.07
3.50	1.949	-0.026	7.060	0.	3.447	12.431	0.	0.	25.306 T	-16.755 T	37.737	42.062	23.41
3.60	0.649	-0.026	2.486	0.	0.975	4.084	0.	0.	18.980 T	-22.153 T	23.064	41.133	23.93
3.70	-0.652	-0.242	-2.088	0.	-1.498	-4.479	0.	0.	13.053 L	-27.808 T	-32.287	40.862	24.00
3.80	-1.952	-0.242	-6.662	0.	-3.970	-12.826	0.	0.	9.474 L	-33.632 T	-46.458	43.106	22.84
3.90	-3.229	-0.242	-11.237	0.	-6.443	-21.150	0.	0.	6.332 L	-39.562 T	-60.712	45.895	0.
4.00	-4.345	-0.242	-15.811	0.	-8.915	-29.313	0.	0.	6.194 T	-45.569 T	-74.881	51.763	0.

SPAN 1 V LANE = 17.751 V 14 FT. = 18.620 SPAN 3 V LANE = 17.751 V 14 FT. = 18.620

EXAMPLE NO.5 DEAD LOAD DEFLECTIONS(INCHES) AT SPAN TWENTIETH POINTS

S.PT	BEAM	PN	WN	WPN	TOT.NC	TOT.C	TOP.DL	S.PT	BEAM	PN	WN	WPN	TOT.NC	TOT.C	TOP.DL
1.05	0.039	0.004	0.136	0.	0.178	0.048	0.227	1.10	0.076	0.007	0.264	0.	0.347	0.093	0.440
1.15	0.109	0.010	0.379	0.	0.498	0.130	0.629	1.20	0.138	0.013	0.478	0.	0.629	0.163	0.792
1.25	0.162	0.016	0.557	0.	0.734	0.190	0.924	1.30	0.179	0.018	0.615	0.	0.811	0.209	1.021
1.35	0.189	0.019	0.650	0.	0.858	0.222	1.080	1.40	0.193	0.020	0.661	0.	0.874	0.226	1.100

1.45	0.190	0.020	0.650	0.	0.859	0.224	1.083	1.50	0.181	0.019	0.617	0.	0.817	0.214	1.030
1.55	0.166	0.018	0.565	0.	0.749	0.197	0.946	1.60	0.147	0.016	0.498	0.	0.661	0.175	0.836
1.65	0.125	0.013	0.420	0.	0.558	0.149	0.707	1.70	0.101	0.010	0.337	0.	0.448	0.120	0.568
1.75	0.077	0.006	0.256	0.	0.339	0.090	0.429	1.80	0.055	0.003	0.182	0.	0.240	0.062	0.303
1.85	0.036	0.000	0.117	0.	0.153	0.038	0.191	1.90	0.019	-0.001	0.062	0.	0.080	0.018	0.098
1.95	0.007	-0.002	0.022	0.	0.027	0.004	0.031								
2.05	0.002	0.005	0.004	0.	0.010	0.009	0.019	2.10	0.012	0.012	0.036	0.	0.060	0.032	0.092
2.15	0.028	0.021	0.088	0.	0.137	0.064	0.201	2.20	0.049	0.032	0.156	0.	0.236	0.102	0.338
2.25	0.074	0.042	0.240	0.	0.355	0.143	0.498	2.30	0.099	0.051	0.328	0.	0.478	0.182	0.660
2.35	0.123	0.058	0.408	0.	0.589	0.216	0.804	2.40	0.141	0.064	0.471	0.	0.676	0.242	0.917
2.45	0.153	0.067	0.512	0.	0.731	0.258	0.989	2.50	0.157	0.068	0.526	0.	0.751	0.263	1.014
2.55	0.153	0.067	0.512	0.	0.731	0.258	0.989	2.60	0.141	0.064	0.471	0.	0.676	0.242	0.917
2.65	0.123	0.058	0.408	0.	0.589	0.216	0.804	2.70	0.099	0.051	0.328	0.	0.478	0.182	0.660
2.75	0.074	0.042	0.240	0.	0.355	0.143	0.498	2.80	0.049	0.032	0.156	0.	0.236	0.102	0.338
2.85	0.028	0.021	0.088	0.	0.137	0.064	0.201	2.90	0.012	0.012	0.036	0.	0.060	0.032	0.092
2.95	0.002	0.005	0.004	0.	0.010	0.009	0.019								
3.05	0.007	-0.002	0.022	0.	0.027	0.004	0.031	3.10	0.019	-0.001	0.062	0.	0.080	0.018	0.098
3.15	0.036	0.000	0.117	0.	0.153	0.038	0.191	3.20	0.055	0.003	0.182	0.	0.240	0.062	0.303
3.25	0.077	0.006	0.256	0.	0.339	0.090	0.429	3.30	0.101	0.010	0.337	0.	0.448	0.120	0.568
3.35	0.125	0.013	0.420	0.	0.558	0.149	0.707	3.40	0.147	0.016	0.498	0.	0.661	0.175	0.836
3.45	0.166	0.018	0.565	0.	0.749	0.197	0.946	3.50	0.181	0.019	0.617	0.	0.817	0.214	1.030
3.55	0.190	0.020	0.650	0.	0.859	0.224	1.083	3.60	0.193	0.020	0.661	0.	0.874	0.226	1.100
3.65	0.189	0.019	0.650	0.	0.858	0.222	1.080	3.70	0.179	0.018	0.615	0.	0.811	0.209	1.021
3.75	0.162	0.016	0.557	0.	0.734	0.190	0.924	3.80	0.138	0.013	0.478	0.	0.629	0.163	0.792
3.85	0.109	0.010	0.379	0.	0.498	0.130	0.629	3.90	0.076	0.007	0.264	0.	0.347	0.093	0.440
3.95	0.039	0.004	0.136	0.	0.178	0.048	0.227								

LIVE LOAD DEFLECTIONS(INCHES)

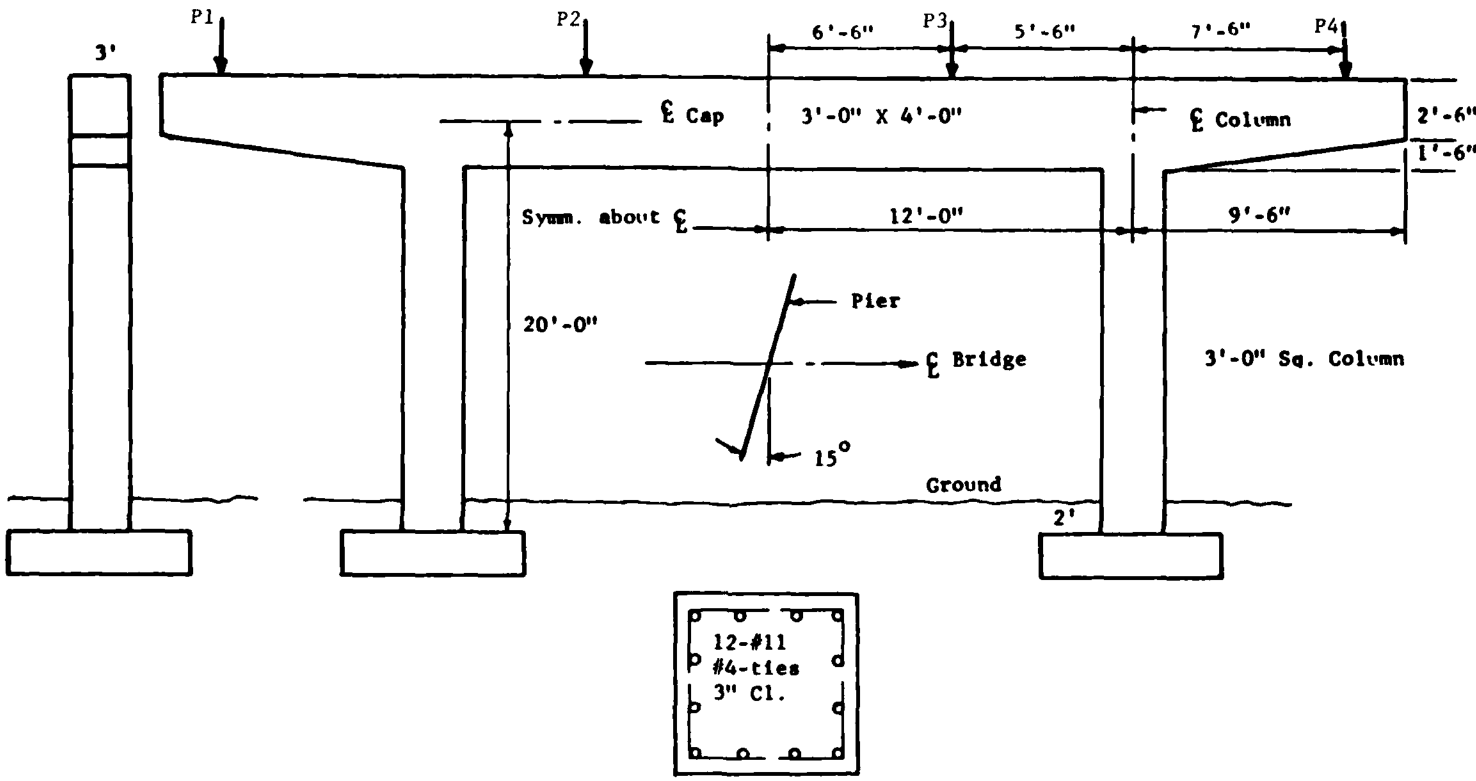
SPAN	AT	LANE	TRUCK	MIL.	SIDEWALK	L/800
1	0.500 L	0.607	0.742	0.532	0.	1.236
2	0.500 L	0.881	1.036	0.729	0.	1.560
3	0.500 L	0.607	0.742	0.532	0.	1.236

Example Problem for BRHMCP

This example is for illustrative purposes only and does not represent an actual design. It is a rather simple example; yet, it is also typical of most piers. First the pier description and loads are given or assumed. The input requirements are shown on the input data forms on page A24. The output data in reduced scale is given on pages A26-A29. Finally, a commentary is given following the output data. The following page contains a sketch of the pier.

Given Data

Column and cap members have a constant moment of inertia.
Columns are assumed fixed at bottom.
Footings are spread with a 5'-0" X 5'-0" X 2'-0" minimum size.
Soil bearing capacity is 8.0 kips per square foot.
Use 3" increments in footing design and limit either width to a maximum of 1½ times the other width.
Soil weighs 120 pounds per cubic foot.
A column stress analysis and footing design are desired.
Centroid of superstructure area is 6'-0" above center line of cap.
For Group II Wind, Group III Wind, and Wind on Live Load use 0° and 60° wind skew angles.
Expansion coefficient equals 3.0×10^{-4}.
Shrinkage coefficient equals 4.4×10^{-4}.
Wind on substructure (equivalent at center line of cap) is 2.424 kips in transverse direction, and 8.360 kips in longitudinal direction.
Longitudinal Force (Traction) is 4.9 kips (one lane).
Centrifugal and Friction forces are not applicable.
Dead load from superstructure and live load cases are given on following page.
Live load impact is 20%.
Lengths for Wind on Live Load are 100.0 (transverse) and 200.0 (longitudinal) feet.
Location of Wind on Live Load and Traction is 11.500 feet above center line of cap.



Column Cross Section

Gravity Load	P_1	P_2	P_3	P_4	No. Lanes
Dead Load Superstructure	100.0	100.0	100.0	100.0	-
Live Load 1001	45.0	15.0	15.0	45.0	2
Live Load 0110	10.0	50.0	50.0	10.0	2
Live Load 1010	45.0	25.0	40.0	10.0	2
Live Load 0101	10.0	40.0	25.0	45.0	2
Live Load 010	0.0	30.0	30.0	0.0	1

<u>INPUT DATA FILE</u>

```
*OLD DATAMCP
READY
*LIST

100 *EX.1 EXAMPLE PIER PROBLEM NO. 1  TWO COLUMN PIER
110 122   5 15 0 02000  - FOR CASE PROJECT - TASK GROUP BRIDGES
120 21 01  20000      3000 3000           200000002156 44205
130 22 1
140 31001  95001500 2500 3000 1500 8000 7500
150 321
160 4101  24000      4000 3000            550013000
170 510 5000 5000 2000 0250 0250 0250 1500 1500 8000 2000 0120
180 521
190 61    5000  1000050 01719              6000 6000 2424 8360
200 6250 01719             100 03438              1000 2000
210 63  4900      1150011500                  30000 44000
220 7100D.L.100000100000100000100000
230 81 21001 45000 15000 15000 45000
240 81 20110 10000 50000 50000 10000
250 81 21010 45000 25000 40000 10000
260 81 20101 10000 40000 25000 45000
270 81 1010   0000 30000 30000  0000

ready

*
```

```
*RUN *RHMCP


        THE ANALYSIS OF MULTIPLE COLUMN PIERS FOR HIGHWAY BRIDGES
         DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION



INPUT NAME OF DATA FILE. = DATAMCP

INPUT NAME OF OUTPUT FILE (1-8 CHARACTERS) OR
GIVE CARRIAGE RETURN IF OUTPUT IS TO COME TO TERMINAL. = OUTMCP

*
```

```
12/06/79          FILE - OUTMCP          12:35     PAGE  1


                    THE ANALYSIS OF MULTIPLE COLUMN PIERS FOR HIGHWAY BRIDGES                    PROB. NO. EX.1

12/05/79                DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION
                      EXAMPLE PIER PROBLEM NO. 1  TWO COLUMN PIER
 NC = 2, CA = 0, FD = 0, NLC =  5, SKEW ANGLE = 15  0  0, I = 20.00%   - FOR CASE PROJECT - TASK GROUP BRIDGES

                                          COLUMN DATA

 N P S C V R    HT      A       DT      BT      DB      BB      DL     FLEX    ND  AS  NB   T      ND  AS  NB   T      SL
 1 0 0 1 0 0  20.000  0.      3.000   3.000   0.      0.      2.000  0.       2 1.56  4 4.205    0 0.    0 0.      0.
 2 0 1 0 0 0   0.     0.      0.      0.      0.      0.      0.     0.       0 0.    0 0.       0 0.    0 0.      0.

                                        CANTILEVER DATA

 N S C L P      C       A       DE      B       DH      LH      X1      X2      X3      X4      X5
 1 0 0 1 0    9.500   1.500   2.500   3.000   1.500   8.000   7.500   0.      0.      0.      0.
 ? 1 0 0 0    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

                                            CAP DATA

 N S C L P      S       A       DC      B       DH      LH      X1      X2      X3      X4      X5      X6      X7      X8
 1 0 1 0 0   24.000   0.      4.000   3.000   0.      0.      5.500  13.000   0.      0.      0.      0.      0.      G.

                                         FOOTING DATA

 N S      B       D       TF      DELB    DELD    DELT    R B/D   R D/B   SBC     HS      WS      DELS
 1 0    5.000   5.000   2.000   0.250   0.250   0.250   1.500   1.500   8.000   2.000   0.120   0.
 2 1    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
                                                GROUP II WIND
SUPERSTRUCTURE AREA *      WIND ON SUPERSTRUCTURE INTENSITIES        * WIND FORCE ARM  * WIND ON PIER

  TRANS.     LONG.    FT1 FL1   FT2 FL2   FT3  FL3   FT4 FL4   FT5 FL5    APT     APL     PT      PL

  500.0     1000.0    50   0    17  19     0    0     0   0     0   0    6.000   6.000   2.424   8.360

                                           GROUP II WIND
```

WIND ON SUPERSTRUCTURE INTENSITIES										*	WIND ON LIVE LOAD INTENSITIES										* L.L. LENGTHS	
FT1	FL1	FT2	FL2	FT3	FL3	FT4	FL4	FT5	FL5		FT1	FL1	FT2	FL2	FT3	FL3	FT4	FL4	FT5	FL5	TRANS.	LONG.
50	0	17	19	0	0	0	0	0	0		100	0	34	38	0	0	0	0	0	0	100.0	200.0

MISCELLANEOUS FORCES

TRACTION	CENTRIFUGAL	T.F.,C.F.,W.ON L.L.ARM		FRICTION	FRICTION FORCE ARM		EXPANSION	SHRINKAGE
FL	FT	APT	APL	FL	APT	APL	COEFF.	COEFF.
4.900	0.	11.500	11.500	0.	0.	0.	3.0000	4.4000

DEAD LOAD SUPERSTRUCTURE AND LIVE LOAD CASES

LOAD CASE	NL	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11
D.L. SUP.		100.000	100.000	100.000	100.000	0.	0.	0.	0.	0.	0.	0.
L.L. 1001	2	45.000	15.000	15.000	45.000	0.	0.	0.	0.	0.	0.	0.
L.L. 0110	2	10.000	50.000	50.000	10.000	0.	0.	0.	0.	0.	0.	0.
L.L. 1010	2	45.000	25.000	40.000	10.000	0.	0.	0.	0.	0.	0.	0.
L.L. 0101	2	10.000	40.000	25.000	45.000	0.	0.	0.	0.	0.	0.	0.
L.L. 010	1	0.	30.000	30.000	0.	0.	0.	0.	0.	0.	0.	0.

MULTIPLE COLUMN PIER PROBLEM EX.1 OUTPUT DATA EXAMPLE PIER PROBLEM NO. 1 TWO COLUMN PIER

COLUMN MOMENTS(KIP-FEET), SHEARS(KIPS), REACTIONS(KIPS)

		TRANVERSE						* LONGITUDINAL			
LOAD	CN	PT	MT	V	PB	MB	R	MT	V	MB	MF
UNIT F.AT CL.CAP	1	0.384	4.611	0.500	0.384	5.389	0.384	1.000	0.500	10.000	10.000
	2	-0.384	4.611	0.500	-0.384	5.389	-0.384	1.000	0.500	10.000	10.000
EXPANSION OF CAP	1	-0.000	78.243	9.805	-0.000	117.853	-0.000				
	2	0.000	-78.243	-9.805	0.000	-117.853	0.000				
SHRINKAGE OF CAP	1	0.000	-114.756	-14.380	0.000	-172.852	0.000				
	2	-0.000	114.756	14.380	-0.000	172.852	-0.000				
DEAD LOAD TOTAL	1	236.000	-152.148	-11.411	260.300	-76.074	260.300				
	2	236.000	152.148	11.411	260.300	76.074	260.300				
GROUP 2 WIND 1 1	1	16.247	122.523	13.286	16.247	143.199	16.247	34.242	7.415	167.716	167.716
	2	-16.247	122.523	13.286	-16.247	143.199	-16.247	34.242	7.415	167.716	167.716
GROUP 2 WIND 1 2	1	16.247	122.523	13.286	16.247	143.199	16.247	34.242	7.415	167.716	167.716
	2	-16.247	122.523	13.286	-16.247	143.199	-16.247	34.242	7.415	167.716	167.716
GROUP 2 WIND 2 1	1	9.258	71.709	7.776	9.258	83.810	9.258	72.971	12.256	293.584	293.584

	2	-9.258	71.709	7.776	-9.258	83.810	-9.258	72.971	12.256	293.584	293.584
GROUP 2 WIND 2 2	1	3.020	26.360	2.858	3.020	30.808	3.020	90.570	14.456	350.783	350.783
	2	-3.020	26.360	2.858	-3.020	30.808	-3.020	90.570	14.456	350.783	350.783
TRACTION (1 LANE)	1	1.095	5.848	0.634	1.095	6.834	1.095	-31.948	-2.367	-74.545	-74.545
	2	-1.095	5.848	0.634	-1.095	6.834	-1.095	-31.948	-2.367	-74.545	-74.545
GROUP 3 WIND 1 1	1	13.214	81.295	8.815	13.214	95.014	13.214	22.727	1.011	40.919	40.919
	2	-13.214	81.295	8.815	-13.214	95.014	-13.214	22.727	1.011	40.919	40.919
GROUP 3 WIND 1 2	1	13.214	81.295	8.815	13.214	95.014	13.214	27.743	3.519	91.079	91.079
	2	-13.214	81.295	8.815	-13.214	95.014	-13.214	27.743	3.519	91.079	91.079
GROUP 3 WIND 2 1	1	7.311	45.726	4.958	7.311	53.442	7.311	-65.503	-6.907	-189.837	-189.837
	2	-7.311	45.726	4.958	-7.311	53.442	-7.311	-65.503	-6.907	-189.837	-189.837
GROUP 3 WIND 2 2	1	2.043	13.981	1.516	2.043	16.340	2.043	82.663	8.447	234.716	234.716
	2	-2.043	13.981	1.516	-2.043	16.340	-2.043	82.663	8.447	234.716	234.716
LIVE LOAD 1001	1	60.000	-137.804	-10.335	60.000	-68.902	60.000				
	2	60.000	137.804	10.335	60.000	68.902	60.000				
LIVE LOAD 0110	1	60.000	68.915	5.169	60.000	34.457	60.000				
	2	60.000	-68.915	-5.169	60.000	-34.457	60.000				
LIVE LOAD 1010	1	83.412	-45.997	-2.583	83.412	-5.670	83.412				
	2	36.588	22.892	2.583	36.588	28.775	36.588				
LIVE LOAD 0101	1	36.588	-22.892	-2.583	36.588	-28.775	36.588				
	2	83.412	45.997	2.583	83.412	5.670	83.412				
LIVE LOAD 010	1	30.000	63.989	4.799	30.000	31.994	30.000				
	2	30.000	-63.989	-4.799	30.000	-31.994	30.000				

CAP DATA

*	MOMENTS(KIP-FEET)					* AS(SQ.IN.) *		SHEARS(KIPS)				* SRP.SP.(IN.)*		P *	FC
POINT	D.L.	GR.1 +	GR.1 -	GR.3 +	GR.3 -	TOP	BOT.	D.L. LT.	D.L. RT.	GR.1 LT.	GR.1 RT.	LT.	RT.	IN.	PSD
C 1L	-812.775	-812.775	-1150.275	-812.775	-1150.275	17.80	3.12	-114.400	0.	-159.400	0.	14.23	36.00	31.15	1146
C 1R	-660.627	-660.627	-952.130	-619.745	-1045.121	14.59	3.12	0.	121.600	0.	171.600	36.00	10.85	33.20	1013
P 2	-19.052	112.033	-136.249	162.402	-186.619	3.12	3.12	111.700	11.700	161.700	25.112	18.55	36.00	29.61	286
P 3	-19.052	112.033	-136.249	162.402	-186.619	3.12	3.12	-11.700	-111.700	-25.112	-161.700	36.00	18.55	29.61	286
C 2L	-660.627	-660.627	-952.130	-619.745	-1045.121	14.59	3.12	-121.600	0.	-171.600	0.	10.85	36.00	33.20	1013
C 2R	-812.775	-812.775	-1150.275	-812.775	-1150.275	17.80	3.12	0.	114.400	0.	159.400	36.00	14.23	31.15	1146

COLUMN STRESS ANALYSIS DATA

POINT	CASE	GR	LLC	WD	WC	M	ML	MT	P	EL	ET	FS	F3	F4	F2	F1	FE	R
TOP 1	MAX.FC	3	1001	2	1R	C	129.399	-347.372	286.499	0.151	0.404	-8020	-1054	-464	513	1103	1500	0.736
TOP 1	MAX.FS	5 S		1	1R	C	34.242	-389.427	219.753	0.052	0.591	-11191	-1402	-1219	840	1023	28000	0.400
BOT.1	MAX.FC	5 S		2	2R	C	350.783	-279.734	257.280	0.454	0.362	-14427	-1837	63	-358	1543	1680	0.918
BOT.1	MAX.FS	5 S		2	1R	C	293.584	-332.736	251.[illegible]42	0.390	0.442	-14445	-1838	-269	-32	1536	28000	0.516
TOP 2	MAX.FC	3	1001	2	1	C	129.399	347.372	286.499	0.151	0.404	-8020	-1054	-464	513	1103	1500	0.736
TOP 2	MAX.FS	5 S		1	1	C	34.242	389.427	219.753	0.052	0.591	-11191	-1402	-1219	840	1023	28000	0.400
BOT.2	MAX.FC	5 S		2	2	C	350.783	279.734	257.280	0.454	0.362	-14427	-1837	63	-358	1543	1680	0.918

12/06/79   FILE - OUTMCP   12:35   PAGE 4

BOT.2 MAX.FS 5 S   2 1 C   293.584   332.736   251.042   0.390   0.442 -14445 -1838   -269   -32   1536 28000   0.516

FOOTING DESIGN LOADS

FOOT	GR	LLC	WD	WC	ML	MT	P	VL	VT	SBC	F3	F4	F2	F1	M/FT.	V/FT.
1 MT	3	1010	2	2R	383.807	-83.470	329.957	13.180	-13.812	10000	152	7500	2142	9489	29.551	10.328
1 ML	4 S	1001	0	0	0.	-306.344	310.300	0.	-34.404	10000	1204	1204	7924	7924	27.478	9.596
1 UL	5 S		2	1	293.584	332.736	251.042	12.256	33.567	11200	-3358	2908	4413	10680	23.013	8.077

FOOTING 2 IDENTICAL TO FOOTING 1

FOOTING DESIGN DATA

FOOTING DIMENSIONS				*	LONGITUDINAL					*	TRANSVERSE				
FOOT	B	D	T		AS/FT	P/FT	JD	FC	FS		AS/FT	P/FT	JD	FC	FS
1	8.750	8.750	2.000		0.75	2.33	19.012	696	25000		0.73	2.27	18.191	702	25000

FOOTING 2 IDENTICAL TO FOOTING 1

Example Problem for BRHGEO

Example 1 shows a two-span bridge located in a 3° curve. The four beams of each span are placed parallel to a centerline chord of that span, and the beams in the adjacent spans meet at a common point (concentric arc intersection) at the centerline of Bent 2. Bents 1 and 3 are parallel to Bent 2 and located by the known normal distances from Bent 2.

The Station of Bent 2 will be chosen as the Reference Point Station. Bents are placed parallel to the Y-axis by using a Reference Angle of 72°. The Limiting Stations are arbitrarily chosen as 19+00 and 21+00. The roadway surface is at a constant rate of superelevation. The curb faces and sidewalks are set up as lanes of superelevation. This requires that six lanes of superelevation be defined. The Vertical Curve Data and dimensions for defining the lanes of superelevation are given in the sketch along with the superelevation rates.

Two sets of Longitudinal Lines are defined in the problem. The beams of Span 1 are defined as PIA, and the beams of Span 2 are defined as PIB. Note that the centerline chord and beam lines are from the centerline of Bent 2 to the B.F.P.R. (Back Face Paving Rest) line of the end bents. The centerlines of the railings are defined for the purpose of computing lengths for rail spacings. In addition, the finished grade elevations at the intersection of the railing lines with the bents will be given. Since the centerline chord and gutter lines are used only as reference lines in this problem, these lines are coded to be skipped in the output data.

The centerline-of-bearings and diaphragms are set up as T-Lines in each span. The diaphragms of Span 1 are located at the one-third points of the centerline chord. The positions of the diaphragms in Span 2 are detailed in the sketch. The centerline-of-bearings in Span 1 are defined as "CONS/DIST" T-Lines. In Span 2 the centerline-of-bearings are defined as "PARL/DIST" T-Lines. Note that in many instances a T-Line can be defined by several combinations of T-Line Codes.

The purpose of this problem, in addition to the ones already stated, is to compute the following data.

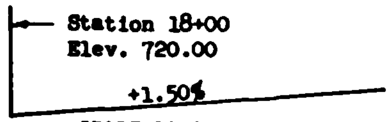
1. Finished grade elevations at centerline-of-bearings.

2. Lengths of beams and diaphragms.

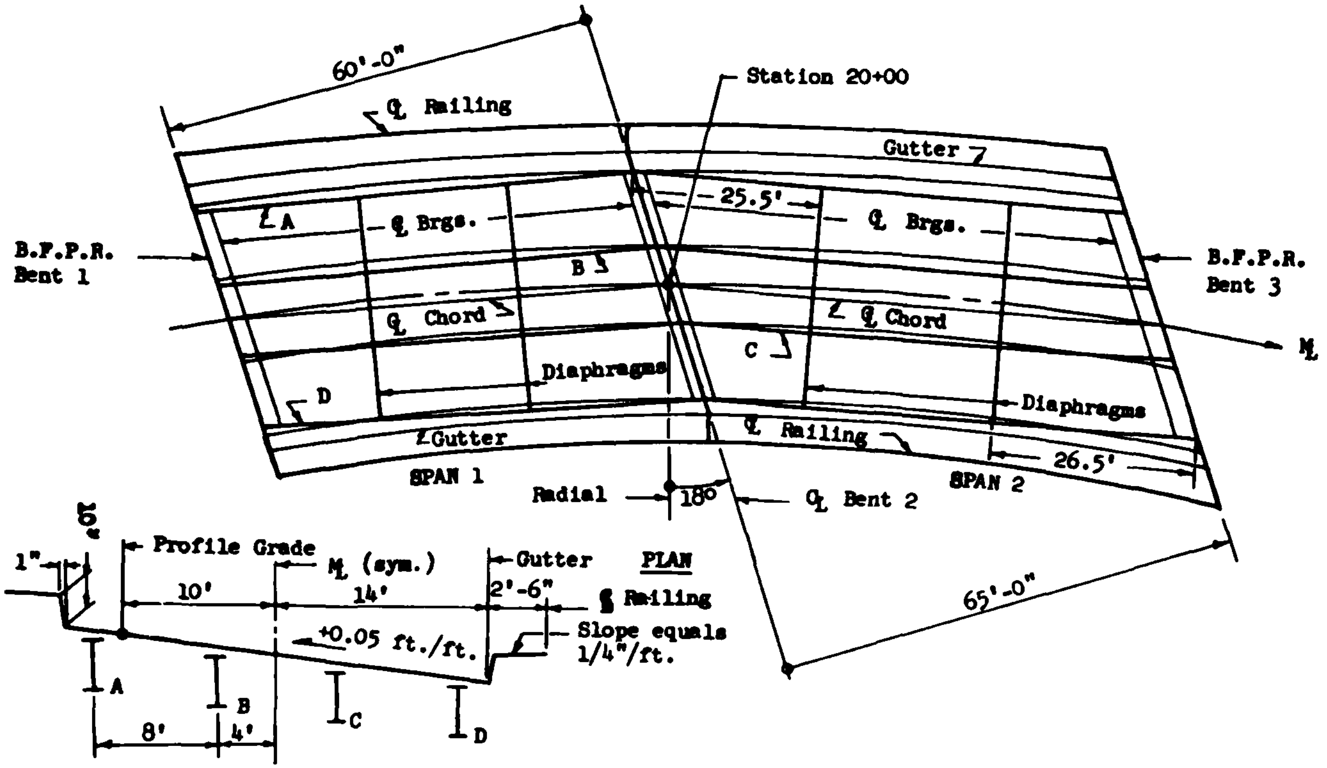
3. Position of diaphragms along each beam.

4. Distance between beams along bent lines.

The centerline-of-bearings are located 6 inches from the centerline of Bent 2 and 1'-6" from the B.F.P.R. of the end bents, along the beams.
Diaphragms are perpendicular to beams.
Beams are placed parallel to the centerline chord.
Beam spacings shown are concentric arc dimensions.
Entire bridge is in 3° curve.



GRADE DATA



CROSS SECTION

INPUT DATA FILE

```
*OLD DATGEOM1
READY
*LIST

1 *EX.1  BRIDGE GEOMETRY  -  EXAMPLE PROBLEM NUMBER 1
2 *FOR CASE PROJECT - TASK GROUP BRIDGES
3 1  19000000  21000000  20000000 72000000
4 2                3000000
5 3  18000000
6 4 7200000  1500000
7 5    -16.5, -140833 10.,-14.,10.,10.,14.,10., 140833 165000
8 6CONST          -02500-120.0 06000 06000120.00 02500
9 701RLG 8     25000                                 LT. RAILING
10 702PIA 9    120000                                 BEAM A
11 703PIA 9     40000                                 BEAM B
12 704ARC       00000                                 CENTERLINE
13 705PIA 9    -40000                                 BEAM C
14 706PIA 9   -120000                                 BEAM D
15 707RLG10    -25000                                 RT. RAILING
16 708ARC      140000                                1LT. GUTTER
17 709CRD       00000                                1CENTERLINE CHORD
18 710ARC     -140000                                1RT. GUTTER
19 711END
20 8SPAN  1  4      FIRST SPAN OF TWO SPAN BRIDGE                          YES
21 B1 1PARL  20000000 1800000   -600000BFPR BT. 1
22 A  2PREV  20000000               CL. BT. 2
23 T01CONSDISTB      15000          CL. BRGS. BT.11  1  1
24 T02ANGLPROPB     03333 9 9000000    DIAPHRAGM 1-1 1  1  1
25 T03ANGLPROPB     06667 9 9000000    DIAPHRAGM 2-1 1  1  1
26 T04CONSDISTA    -05000           CL.BRGS.BT.2BK1  1  1
27 701RLG 8     25000                                 LT. RAILING
28 702PIB 9    120000                                 BEAM A
29 703PIB 9     40000                                 BEAM B
30 704ARC       00000                                 CENTERLINE
31 705PIB 9    -40000                                 BEAM C
32 706PIB 9   -120000                                 BEAM D
33 707RLG10    -25000                                 RT. RAILING
34 708ARC      140000                                1LT. GUTTER
35 709CRD       00000                                1CENTERLINE CHORD
36 710ARC     -140000                                1RT. GUTTER
37 711END
38 8SPAN  2  4 LAST SECOND SPAN OF TWO SPAN BRIDGE
39 B   SAME
40 A1 3PREV                   650000BFPR BT. 3
41 T01PARLDISTB     05000 9         CL.BRGS.BT.2AH1  1  1
42 T02ANGLDISTB    255000 2 9000000    DIAPHRAGM 1-2 1  1  1
43 T03ANGLDISTA   -265000 6 9000000    DIAPHRAGM 2-2 1  1  1
44 T04PARLDISTA    -15000 9         CL.BRGS. BT. 31  1  1
45 9

ready

*
```

```
*RUN BRHGEO


           THE GEOMETRIC SOLUTION OF HIGHWAY BRIDGES
      DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION

INPUT NAME OF DATA FILE. = DATGEOM1

INPUT NAME OF OUTPUT FILE (1-8 CHARACTERS) OR
GIVE CARRIAGE RETURN IF OUTPUT IS TO COME TO TERMINAL. = OUTGEOM

*
```

THE GEOMETRIC SOLUTION OF HIGHWAY BRIDGES PROB. NO. EX.1

DEVELOPED BY THE GEORGIA DEPARTMENT OF TRANSPORTATION

12/05/79

BRIDGE GEOMETRY - EXAMPLE PROBLEM NUMBER 1
FORCASE PROJECT - TASK GROUP BRIDGES

LOCATION DATA

BACK STA.	AHEAD STA.	REF. STA.	REF. ANGLE	REF. DIST.
1900.0000	2100.0000	2000.0000	72- 0- 0.	0.

HORIZONTAL CURVE DATA

CURVE NO. 1	P.C. STA.	CURVE NO. 2	P.T. STA.	CURVE NO. 3
0- 0- 0.	0.	3- 0- 0.	0.	0- 0- 0.

VERTICAL CURVE DATA

PVI Z STA.	PVI 1 STA.	PVI 2 STA.
1800.0000	0.	0.

EL. PVI Z	% GR. Z-1	LVC 1	% GR. 1-2	LVC 2	% GR. 2-3
720.0000	1.500000	0.	0.	0.	0.

CROWN AND LANE DEFINATIONS

CODE	S.R.INS.	S.R. 1	INS.PIV.	S.R. 2	S.R. 3	S.R.OUTS.	S.R. 4	OUTS.PIV.	S.R. 5	S.R. 6
	-16.5000	-14.0833	10.0000	-14.0000	10.0000	10.0000	14.0000	10.0000	14.0833	16.5000

SUPERELEVATION DATA

DESC.	AT STATION	S.E. 1	S.E. 2	S.E. 3	S.E. 4	S.E. 5	S.E. 6
CONST	0.	-0.2500	-120.0000	0.6000	0.6000	120.0000	0.2500

LONGITUDINAL LINES

NO.	TYPE	REF.	DR / X1	STA./ Y1	TR / R / X2	Y2	SK.	REMARKS
1	RLG	8	2.5000	0.	0.	0.	0	LT. RAILING
2	PIA	9	12.0000	0.	0.	0.	0	BEAM A
3	PIA	9	4.0000	0.	0.	0.	0	BEAM B
4	ARC	0	0.	0.	0.	0.	0	CENTERLINE
5	PIA	9	-4.0000	0.	0.	0.	0	BEAM C
6	PIA	9	-12.0000	0.	0.	0.	0	BEAM D
7	RLG	10	-2.5000	0.	0.	0.	0	RT. RAILING
8	ARC	0	14.0000	0.	0.	0.	1	LT. GUTTER
9	CRD	0	0.	0.	0.	0.	1	CENTERLINE CHORD

10	ARC	0	-14.0000	0.	0.	0.	1	RT. GUTTER
11	END							

SPAN 1 INPUT DATA

4 T-LINES FIRST SPAN OF TWO SPAN BRIDGE YES

BENT DATA

	C	NO.	TYPE	STATION	SKEW ANGLE	STA./NORM.	REMARKS	LONGITUDINAL LINE SKIPS
B	1	1	PARL	2000.0000	18- 0- 0.	-60.0000	BFPR BT. 1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
A	0	2	PREV	2000.0000	0- 0- 0.	0.	CL. BT. 2	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

T-LINE DATA

NO.	LINE CODE	B	S/N/D/P/X	RL	A/S/D/P/Y	B	RL	C	REMARKS	LONGITUDINAL LINE SKIPS
1	CONS/DIST	B	1.5000	0	0.		0	0	CL. BRGS. BT.1	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2	ANGL/PROP	B	0.3333	9	90- 0- 0.		0	0	DIAPHRAGM 1-1	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
3	ANGL/PROP	B	0.6667	9	90- 0- 0.		0	0	DIAPHRAGM 2-1	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
4	CONS/DIST	A	-0.5000	0	0.		0	0	CL.BRGS.BT.2BK	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

SPAN 1 OUTPUT DATA FIRST SPAN OF TWO SPAN BRIDGE PROB. NO. EX.1

BENT DATA

BT.	NO.	STATION	SKEW ANGLE	REMARKS	TYPE
B	1	19+37.2360	16-07-01.5	BFPR BT. 1	PARL
A	2	20+00.	18-00-00.	CL. BT. 2	PREV

LONG. LINE 1 RLG LT. RAILING

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 1	19+32.5107	723.0710*	16.5000	0.	0.	15-58-31.2	530.1790	1851.9639	BFPR BT. 1	PARL
B 2	19+95.4860	724.0156*	16.5000	63.5193	0.	0-00-00.	590.9459	1833.4784	CL. BT. 2	PREV

LONG. LINE 2 PIA BEAM A

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 1	19+33.7566	722.1124	12.1208	0.	4.5555	-72-56-29.3	530.1790	1847.4084	BFPR BT. 1	PARL
T 1	19+35.2469	722.1334	12.0940	1.5000	0.	0-00-00.	531.6130	1846.9684	CL. BRGS. BT.1	CONS/DIST
T 2	19+58.2201	722.4648	11.8291	24.6184	0.	90-00-00.	553.7143	1840.1867	DIAPHRAGM 1-1	ANGL/PROP
T 3	19+79.0159	722.7767	11.8291	45.5430	0.	90-00-00.	573.7183	1834.0485	DIAPHRAGM 2-1	ANGL/PROP
T 4	19+95.6298	723.0341	11.9929	62.2611	0.	0-00-00.	589.7010	1829.1442	CL.BRGS.BT.2BK	CONS/DIST
B 2	19+96.1266	723.0419	12.0000	62.7611	4.5460	-72-56-29.3	590.1790	1828.9975	CL. BT. 2	PREV

LONG. LINE 3 PIA BEAM B

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 1	19+36.0711	721.7431	4.0405	0.	8.4080	-72-56-29.3	530.1790	1839.0004	BFPR BT. 1	PARL
T 1	19+37.5677	721.7643	4.0155	1.5000	0.	0-00-00.	531.6130	1838.5604	CL. BRGS. BT.1	CONS/DIST
T 2	19+58.1764	722.0622	3.7911	22.1519	8.0381	90-00-00.	551.3564	1832.5022	DIAPHRAGM 1-1	ANGL/PROP
T 3	19+79.0596	722.3755	3.7911	43.0765	8.0381	90-00-00.	571.3604	1826.3640	DIAPHRAGM 2-1	ANGL/PROP
T 4	19+98.2043	722.6727	3.9922	62.2611	0.	0-00-00.	589.7010	1820.7362	CL.BRGS.BT.2BK	CONS/DIST

B 2	19+98.7032	722.6805	4.0000	62.7611	8.4080	-72-56-29.3	590.1790	1820.5895	CL. BT. 2	PREV

LONG. LINE 4 ARC CENTERLINE

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 1	19+37.2360	721.5585	0.0000	0.	4.2054	16-07-01.5	530.1790	1834.7950	BFPR BT. 1	PARL
B 2	20+00.	722.5000	0.0000	62.7640	4.2054	18-00-00.	590.1790	1816.3841	CL. BT. 2	PREV

LONG. LINE 5 PIA BEAM C

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 1	19+38.4062	721.3741	-4.0406	0.	4.2063	-72-56-29.3	530.1790	1830.5887	BFPR BT. 1	PARL
T 1	19+39.9092	721.3954	-4.0638	1.5000	0.	0-00-00.	531.6130	1830.1487	CL. BRGS. BT.1	CONS/DIST
T 2	19+58.1323	721.6595	-4.2504	19.6844	0.	90-00-00.	548.9974	1824.8143	DIAPHRAGM 1-1	ANGL/PROP
T 3	19+79.1037	721.9740	-4.2504	40.6089	0.	90-00-00.	569.0014	1818.6762	DIAPHRAGM 2-1	ANGL/PROP
T 4	20+00.8016	722.3116	-4.0085	62.2611	0.	0-00-00.	589.7010	1812.3245	CL.BRGS.BT.2BK	CONS/DIST
B 2	20+01.3026	722.3195	-4.0000	62.7611	4.2063	-72-56-29.3	590.1790	1812.1778	CL. BT. 2	PREV

LONG. LINE 6 PIA BEAM D

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 1	19+40.7622	721.0053	-12.1224	0.	8.4154	-72-56-29.3	530.1790	1822.1733	BFPR BT. 1	PARL
T 1	19+42.2717	721.0269	-12.1437	1.5000	0.	0-00-00.	531.6130	1821.7333	CL. BRGS. BT.1	CONS/DIST
T 2	19+58.0879	721.2565	-12.2955	17.2157	8.0452	90-00-00.	546.6373	1817.1231	DIAPHRAGM 1-1	ANGL/PROP
T 3	19+79.1481	721.5724	-12.2955	38.[illegible]403	8.0452	90-00-00.	566.6413	1810.9849	DIAPHRAGM 2-1	ANGL/PROP
T 4	20+03.4219	721.9509	-12.0092	62.2611	0.	0-00-00.	589.7010	1803.9091	CL.BRGS.BT.2BK	CONS/DIST
B 2	20+03.9250	721.9589	-12.0000	62.7611	8.4154	-72-56-29.3	590.1790	1803.7624	CL. BT. 2	PREV

LONG. LINE 7 RLG RT. RAILING

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 1	19+42.0471	721.8141	-16.5000	0.	4.5595	16-15-41.1	530.1790	1817.6138	BFPR BT. 1	PARL
B 2	20+04.5843	722.7521	-16.5000	61.9968	4.5473	0-00-00.	589.4007	1799.2822	CL. BT. 2	PREV

LONGITUDINAL LINES

NO.	TYPE	REF.	DR / X1	STA./ Y1	TR / R / X2	Y2	SK.	REMARKS
1	RLG	8	2.5000	0.	0.	0.	0	LT. RAILING
2	PIB	9	12.0000	0.	0.	0.	0	BEAM A
3	PIB	9	4.0000	0.	0.	0.	0	BEAM B
4	ARC	0	0.	0.	0.	0.	0	CENTERLINE
5	PIB	9	-4.0000	0.	0.	0.	0	BEAM C
6	PIB	9	-12.0000	0.	0.	0.	0	BEAM D
7	RLG	10	-2.5000	0.	0.	0.	0	RT. RAILING
8	ARC	0	14.0000	0.	0.	0.	1	LT. GUTTER
9	CRD	0	0.	0.	0.	0.	1	CENTERLINE CHORD
10	ARC	0	-14.0000	0.	0.	0.	1	RT. GUTTER
11	END							

SPAN 2 INPUT DATA

4 T-LINES LAST SECOND SPAN OF TWO SPAN BRIDGE

	C	NO.	TYPE	STATION	SKEW ANGLE	STA./NORM.	BENT DATA REMARKS	LONGITUDINAL LINE SKIPS
B	0		SAME	0.	0- 0- 0.	0.		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
A	1	3	PREV	0.	0- 0- 0.	65.0000	BFPR BT. 3	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

NO.	LINE CODE	B	S/N/D/P/X	RL	A/S/D/P/Y	B	RL	C	T-LINE DATA REMARKS	LONGITUDINAL LINE SKIPS
1	PARL/DIST	B	0.5000	9	0.		0	0	CL.BRGS.BT.2AH	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
2	ANGL/DIST	B	25.5000	2	90- 0- 0.		0	0	DIAPHRAGM 1-2	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
3	ANGL/DIST	A	-26.5000	6	90- 0- 0.		0	0	DIAPHRAGM 2-2	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
4	PARL/DIST	A	-1.5000	9	0.		0	0	CL.BRGS. BT. 3	1 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

SPAN 2 OUTPUT DATA SECOND SPAN OF TWO SPAN BRIDGE PROB. NO. EX.1

BT.	NO.	STATION	BENT DATA SKEW ANGLE	REMARKS	TYPE
B	2	20+00.	18-00-00.	CL. BT. 2	SAME
A	3	20+68.7621	20-03-46.3	BFPR BT. 3	PREV

LONG. LINE 1 RLG LT. RAILING

T-LINE		STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B	2	19+95.4860	724.0156*	16.5000	0.	0.	0-00-00.	590.9459	1833.4784	CL. BT. 2	SAME
B	3	20+62.7911	725.0252*	16.5000	67.8866	0.	19-53-01.4	655.1790	1811.5189	BFPR BT. 3	PREV

LONG. LINE 2 PIB BEAM A

T-LINE		STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B	2	19+96.1266	723.0419	12.0000	0.	4.5460	-70-58-06.8	590.1790	1828.9975	CL. BT. 2	SAME
T	1	19+96.6234	723.0489	11.9901	0.5000	0.	-70-58-06.8	590.6517	1828.8345	CL.BRGS.BT.2AH	PARL/DIST
T	2	20+21.4675	723.4349	11.6584	25.5000	0.	90-00-00.	614.2852	1820.6823	DIAPHRAGM 1-2	ANGL/DIST
T	3	20+46.3033	723.7771	11.6519	50.4872	0.	90-00-00.	637.9065	1812.5343	DIAPHRAGM 2-2	ANGL/DIST
T	4	20+62.9711	724.0361	11.8298	67.2583	0.	-70-58-06.8	653.7610	1807.0655	CL.BRGS. BT. 3	PARL/DIST
B	3	20+64.4617	724.0596	11.8528	68.7583	4.9425	-70-58-06.8	655.1790	1806.5764	BFPR BT. 3	PREV

LONG. LINE 3 PIB BEAM B

T-LINE		STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B	2	19+98.7032	722.6805	4.0000	0.	8.4080	-70-58-06.8	590.1790	1820.5895	CL. BT. 2	SAME
T	1	19+99.2021	722.6876	3.9907	0.5000	8.4080	-70-58-06.8	590.6517	1820.4265	CL.BRGS.BT.2AH	PARL/DIST
T	2	20+21.4139	723.0067	3.7102	22.7583	7.9484	90-00-00.	611.6933	1813.1684	DIAPHRAGM 1-2	ANGL/DIST
T	3	20+46.3529	723.3805	3.7037	47.7455	7.9484	90-00-00.	635.3147	1805.0204	DIAPHRAGM 2-2	ANGL/DIST
T	4	20+65.8257	723.6837	3.9254	67.2583	8.4080	-70-58-06.8	653.7610	1798.6575	CL.BRGS. BT. 3	PARL/DIST
B	3	20+67.3224	723.7074	3.9507	68.7583	8.4080	-70-58-06.8	655.1790	1798.1683	BFPR BT. 3	PREV

LONG. LINE 4 ARC CENTERLINE

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 2	20+00.	722.5000	0.0000	0.	4.2054	18-00-00.	590.1790	1816.3841	CL. BT. 2	SAME
B 3	20+68.7621	723.5314	0.0000	68.7621	4.2054	20-03-46.3	655.1790	1793.9630	BFPR BT. 3	PREV

LONG. LINE 5 PIB BEAM C

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 2	20+01.3026	722.3195	-4.0000	0.	4.2063	-70-58-06.8	590.1790	1812.1778	CL. BT. 2	SAME
T 1	20+01.8035	722.3266	-4.0086	0.5000	0.	-70-58-06.8	590.6517	1812.0148	CL.BRGS.BT.2AH	PARL/DIST
T 2	20+21.3598	722.6083	-4.2416	20.0153	0.	90-00-00.	609.1003	1805.6511	DIAPHRAGM 1-2	ANGL/DIST
T 3	20+46.4028	722.9836	-4.2481	45.0025	0.	90-00-00.	632.7216	1797.5031	DIAPHRAGM 2-2	ANGL/DIST
T 4	20+68.7052	723.3317	-3.9781	67.2583	0.	-70-58-06.8	653.7610	1790.2458	CL.BRGS. BT. 3	PARL/DIST
B 3	20+70.2080	723.3556	-3.9505	68.7583	4.2063	-70-58-06.8	655.1790	1789.7566	BFPR BT. 3	PREV

LONG. LINE 6 PIB BEAM D

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 2	20+03.9250	721.9589	-12.0000	0.	8.4154	-70-58-06.8	590.1790	1803.7624	CL. BT. 2	SAME
T 1	20+04.4281	721.9660	-12.0079	0.5000	8.4154	-70-58-06.8	590.6517	1803.5993	CL.BRGS.BT.2AH	PARL/DIST
T 2	20+21.3052	722.2097	-12.1968	17.2712	7.9555	90-00-00.	606.5061	1798.1305	DIAPHRAGM 1-2	ANGL/DIST
T 3	20+46.4532	722.5866	-12.2034	42.2583	7.9555	90-00-00.	630.1275	1789.9825	DIAPHRAGM 2-2	ANGL/DIST
T 4	20+71.6099	722.9801	-11.8807	67.2583	8.4154	-70-58-06.8	653.7610	1781.8303	CL.BRGS. BT. 3	PARL/DIST
B 3	20+73.1190	723.0042	-11.8509	68.7583	8.4154	-70-58-06.8	655.1790	1781.3412	BFPR BT. 3	PREV

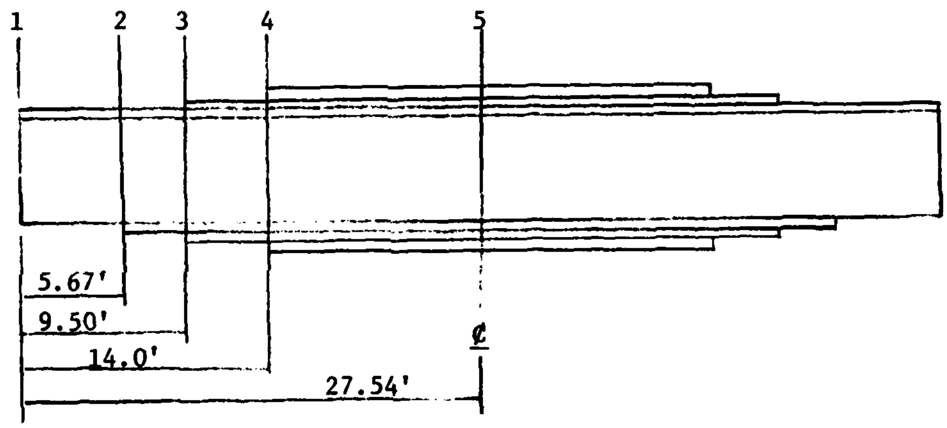
LONG. LINE 7 RLG RT. RAILING

T-LINE	STATION	ELEVATION	ST TO ML	DT TO BT	DT TO PP	ANGLE	X	Y	REMARKS	TYPE LINE
B 2	20+04.5843	722.7521	-16.5000	0.	4.5473	0-00-00.	589.4007	1799.2822	CL. BT. 2	SAME
B 3	20+74.8441	723.8060	-16.5000	69.6529	4.9544	20-14-43.2	655.1790	1776.3868	BFPR BT. 3	PREV

Example Problem for BRRPLG

SAMPLE PLATE GIRDER

FOR BRRPLG--ANALYSIS OF GIRDER



SPAN = 55.08 ft

CENTER-TO-CENTER GIRDERS 6.50 ft

DIESEL IMPACT

E 80 LOADING

WEB PLATE	54 by 1/2
FLANGE ANGLES	8 by 8 by 5/8
COVER PLATES	20 by 5/8
	and 20 by 1/2

INPUT DATA FILE

*LIST DATR5

```
10 SAMPLE PROBLEM - 55.08 FT. GIRDER - CASE TASK GROUP BRIDGES
20     1     0     1     0     0     6.500     0.500    11.580     0.        0.
30     5    55.080      0.812     0
40     0.
50     5.6700
60     9.5000
70    14.0000
80    27.5400
90     3     0
100     80.000
110     1     1     0     54.500     54.000      0.500
120      8.000      8.000      0.625      8.000      8.000      0.625
130     20.000      0.625
140      2.500     12.000      2.000      1.000      1.000
150     1.0000
160     1.0000
170     1.0000
180     1.0000
190     1.0000
200     1.0000
210     1.0000
220     1.0000
230     1.0000
240     1.0000
250     1.0000
260     1.0000
270     3.0000
280     6.5000
290     5.7500
300     3.0000
310     3.0000
320     3.0000
330     6.0000
340     3.0000
350     3.0000
360     3.0000
370     5.7500
380     6.5000
390     1     1     0     54.500     54.000      0.500
400      8.000      8.000      0.625      8.000      8.000      0.625
410     20.000      0.625
420      2.500      2.000      2.000      1.000      1.000
430     1.0000
440     1.0000
450     3.0000
460    51.5000
470     1     1     1     54.500     54.000      0.500
480      8.000      8.000      0.625      8.000      8.000      0.625
490     20.000      0.625
500     20.000      0.625
510      2.500      2.000      2.000      1.000      1.000
520     1.0000
530     1.0000
540     3.0000
550    51.5000
560     1     2     2     54.500     54.000      0.500
570      8.000      8.000      0.625      8.000      8.000      0.625
```

```
580    20.000     0.625
590    20.000     0.500
600    20.000     0.625
610    20.000     0.500
620     2.500     2.000     2.000     1.000     1.000
630    1.0000
640    1.0000
650    3.0000
660   51.5000
670    1      3     3    54.500    54.000    0.500
680     8.000     8.000     0.625     8.000     8.000     0.625
690    20.000     0.625
700    20.000     0.500
710    20.000     0.500
720    20.000     0.625
730    20.000     0.500
740    20.000     0.500
750     2.500    12.000     3.000     1.000     1.000
760    1.0000
770    1.0000
780    1.0000
790    1.0000
800    1.0000
810    1.0000
820    1.0000
830    1.0000
840    1.0000
850    1.0000
860    1.0000
870    1.0000
880    3.0000
890    6.5000
900    5.7500
910    3.0000
920    3.0000
930    3.0000
940    6.0000
950    3.0000
960    3.0000
970    3.0000
980    5.7500
990    6.5000

ready

*
```

```
*RUN BRRPLG

INPUT DATA FILE NAME IN 8 CHARACTERS OR LESS.
HIT CARRIAGE RETURN IF DATA IS TO COME FROM TERMIANL.

=DATR5

INPUT A FILE NAME FOR OUTPUT IN 8 CHARACTERS OR LESS.
HIT A CARRIAGE RETURN IF OUTPUT IS TO BE PRINTED ON TERMINAL.

=OUTR5

*
```

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
CHICAGO,ILLINOIS
REVISED DEC.1975

SAMPLE PROBLEM - 55.00 FT. GIRDER - CASE TASK GROUP BRIDGES

GIRDER ANALYSIS

DECK PLATE GIRDER 55.08 FT SPAN

C-C GIRDERS 6.50 0.500 AXLE LOAD TO EACH GIRDER

UNIFORM DEAD LOAD 0.812 KIPS/FT

DIESEL LOCOMOTIVE

UNBALLASTED DECK
1969 AREA SPECIFICATIONS

LOADING E 80.0

SECTION PROPERTIES

SECTION 1 TYPE 1 0. FT FROM LEFT SUPPORT
WEB PLATE 54.000 X 0.500
TOP ANGLES 8.000 X 8.000 X 0.625
BOTTOM ANGLES 8.000 X 8.000 X 0.625
BACK-BACK ANGLES 54.500
TOP PLATES
20.000 X 0.625

OPEN HOLES
TOP FLANGE 2.5 1.000 IN. O.H.
BOT FLANGE 2.0 1.000 IN. O.H.
WEB 12.0 O.H.

SIZE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SIZE	1.000	1.000	1.000	1.000	1.000		
SPACE	3.000	6.500	5.750	3.000	3.000	3.000	6.000
SPACE	3.000	3.000	3.000	5.750	6.500		

CENTROID 22.829

```
GROSS MOMENT OF INERTIA  38831.81      SECTION MODULUS   1655.63
NET MOMENT OF INERTIA    32856.97      SECTION MODULUS   1037.46

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS  3.90




SECTION 2  TYPE 1     5.67 FT FROM LEFT SUPPORT
WEB PLATE    54.000 X 0.500
TOP ANGLES     8.000 X  8.000 X 0.625
BOTTOM ANGLES  8.000 X  8.000 X 0.625
BACK-BACK ANGLES    54.500
TOP PLATES
 20.000 X 0.625

OPEN HOLES
    TOP FLANGE  2.5   1.000 IN. O.H.
    BOT FLANGE  2.0   1.000 IN. O.H.
    WEB  2.0 O.H.
    SIZE     1.000   1.000
    SPACE    3.000  51.500

CENTROID    22.829

GROSS MOMENT OF INERTIA  38831.81      SECTION MODULUS   1655.63
NET MOMENT OF INERTIA    33222.95      SECTION MODULUS   1049.02

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS  3.90




SECTION 3  TYPE 1     9.50 FT FROM LEFT SUPPORT
WEB PLATE    54.000 X 0.500
TOP ANGLES     8.000 X  8.000 X 0.625
BOTTOM ANGLES  8.000 X  8.000 X 0.625
BACK-BACK ANGLES    54.500
TOP PLATES
 20.000 X 0.625

BOTTOM PLATES
 20.000 X 0.625

OPEN HOLES
    TOP FLANGE  2.5   1.000 IN. O.H.
    BOT FLANGE  2.0   1.000 IN. O.H.
```

```
    WEB  2.0 O.H.
    SIZE     1.000   1.000
    SPACE    3.000  51.500

CENTROID    27.250

GROSS MOMENT OF INERTIA  49851.40      SECTION MODULUS   1788.39
NET MOMENT OF INERTIA    43118.58      SECTION MODULUS   1546.85

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS  3.80



SECTION 4  TYPE 1    14.00 FT FROM LEFT SUPPORT
WEB PLATE    54.000 X 0.500
TOP ANGLES     8.000 X  8.000 X 0.625
BOTTOM ANGLES  8.000 X  8.000 X 0.625
BACK-BACK ANGLES    54.500
TOP PLATES
 20.000 X 0.625
 20.000 X 0.500

BOTTOM PLATES
 20.000 X 0.625
 20.000 X 0.500

OPEN HOLES
    TOP FLANGE  2.5   1.000 IN. O.H.
    BOT FLANGE  2.0   1.000 IN. O.H.
    WEB  2.0 O.H.
    SIZE     1.000   1.000
    SPACE    3.000  51.500

CENTROID    27.250

GROSS MOMENT OF INERTIA  65601.89      SECTION MODULUS   2311.96
NET MOMENT OF INERTIA    57097.19      SECTION MODULUS   2012.24

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS  4.23



SECTION 5  TYPE 1    27.54 FT FROM LEFT SUPPORT
WEB PLATE    54.000 X 0.500
TOP ANGLES     8.000 X  8.000 X 0.625
BOTTOM ANGLES  8.000 X  8.000 X 0.625
```

BACK-BACK ANGLES 54.500
TOP PLATES
20.000 X 0.625
20.000 X 0.500
20.000 X 0.500

BOTTOM PLATES
20.000 X 0.625
20.000 X 0.500
20.000 X 0.500

OPEN HOLES
TOP FLANGE 2.5 1.000 IN. O.H.
BOT FLANGE 3.0 1.000 IN. O.H.
WEB 12.0 O.H.

SIZE	1.000	1.000	1.000	1.000	1.000	1.000	1.000
SIZE	1.000	1.000	1.000	1.000	1.000		
SPACE	3.000	6.500	5.750	3.000	3.000	3.000	6.000
SPACE	3.000	3.000	3.000	5.750	6.500		

CENTROID 27.250

GROSS MOMENT OF INERTIA 81918.64 SECTION MODULUS 2837.01
NET MOMENT OF INERTIA 69987.20 SECTION MODULUS 2423.80

RADIUS OF GYRATION OF COMP AREA ABOUT WEAK AXIS 4.50
1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
CHICAGO,ILLINOIS
REVISED DEC.1975
SAMPLE PROBLEM - 55.00 FT. GIRDER - CASE TASK GROUP BRIDGES

GIRDER ANALYSIS

DECK PLATE GIRDER 55.08 FT SPAN

C-C GIRDERS 6.50 0.500 AXLE LOAD TO EACH GIRDER

UNIFORM DEAD LOAD 0.812 KIPS/FT

DIESEL LOCOMOTIVE

UNBALLASTED DECK
1969 AREA SPECIFICATIONS

DEAD LOAD VALUES

UNIFORM DEAD LOAD 0.81 KIPS PER FT (EACH GIRDER)

POINT	DIST FROM LEFT SUPPORT (FT)	DEAD MOMENT (FT-KIPS)	DEAD SHEAR (KIPS)	PANEL (FT)
1	0.	0.	22.	0.
2	5.67	114.	18.	0.
3	9.50	176.	15.	0.
4	14.00	233.	11.	0.
5	27.54	308.	0.	0.

LIVE LOAD
(NO IMPACT)

POINT	DIST FROM LEFT SUPPORT (FT)	MOMENT (FT-KIPS)	POSITIVE SHEAR (KIPS)	NEGATIVE SHEAR (KIPS)	GROSS I (IN-4)	
	MODULUS (COMP) (IN-3)	COMP STRESS (KSI)	NET I (IN-4)	MODULUS (TEN) (IN-3)	TEN STRESS (KSI)	WEB AREA (IN-2)	WEB SHEAR (KSI)
1	0.	0.	185.	0.	38832.		
	1656.	0.	32857.	1037.	0.	27.00	6.87
2	5.67	881.	155.	-2.	38832.		
	1656.	6.38	33223.	1049.	10.07	27.00	5.75
3	9.50	1333.	136.	-5.	49851.		
	1788.	8.94	43119.	1547.	10.34	27.00	5.03
4	14.00	1756.	113.	-10.	65602.		
	2312.	9.11	57097.	2012.	10.47	27.00	4.17
5	27.54	2239.	53.	-53.	81919.		
	2837.	9.47	69987.	2424.	11.08	27.00	1.96

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
CHICAGO,ILLINOIS
REVISED DEC.1975

SAMPLE PROBLEM - 55.00 FT. GIRDER - CASE TASK GROUP BRIDGES

GIRDER ANALYSIS

DECK PLATE GIRDER 55.08 FT SPAN

C-C GIRDERS 6.50 0.500 AXLE LOAD TO EACH GIRDER

UNIFORM DEAD LOAD 0.812 KIPS/FT

DIESEL LOCOMOTIVE

UNBALLASTED DECK
1969 AREA SPECIFICATIONS

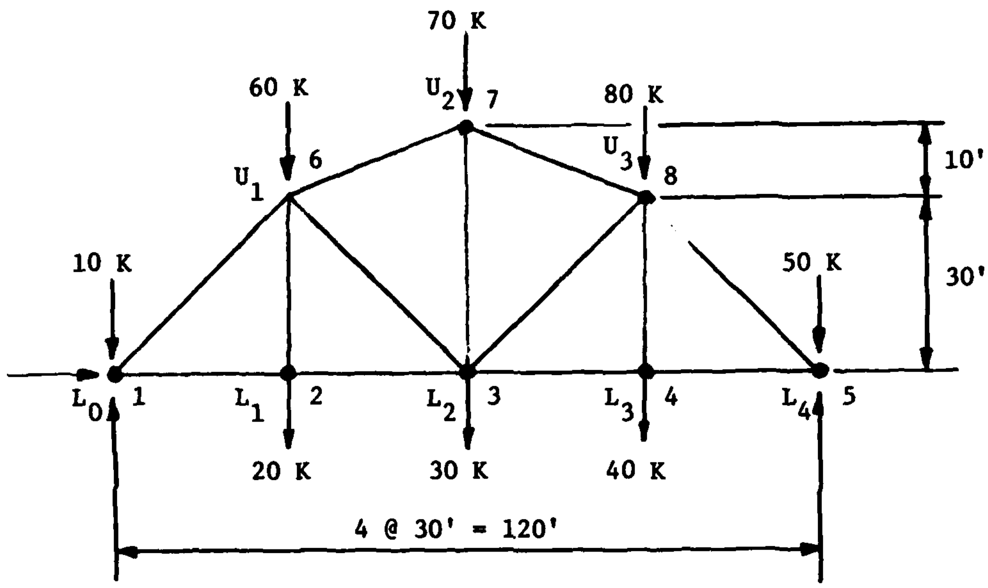
TOTALS

POINT	DIST FROM LEFT SUPPORT (FT)	DEAD MOMENT (FT-KIPS)	LIVE MOMENT (FT-KIPS)	IMPACT (FT-KIPS)	TOTAL MOMENT (FT-KIPS)	
DEAD SHEAR (KIPS)	LIVE SHEAR (KIPS)	IMPACT (KIPS)	TOTAL SHEAR (KIPS)	COMP STRESS (KSI)	TEN STRESS (KSI)	SHEAR STRESS (KSI)
1	0.	0.	0.	0.	0.	
22.	185.	92.	300.	0.	0.	11.11
2	5.67	114.	881.	438.	1432.	
18.	155.	77.	250.	10.38	16.38	9.27
3	9.50	176.	1333.	662.	2171.	
15.	136.	67.	218.	14.57	16.84	8.07
4	14.00	233.	1756.	873.	2862.	
11.	113.	56.	179.	14.86	17.07	6.65
5	27.54	308.	2239.	1113.	3659.	
0.	53.	26.	79.	15.48	18.12	2.93

Example Problem for BRRTRU

SAMPLE TRUSS--8 JOINTS, 13 BARS

FOR BRRTRU--ANALYSIS OF TRUSSES



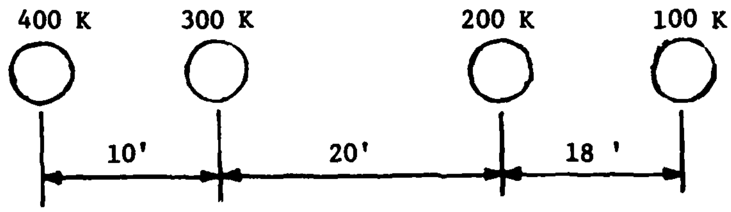
CENTER-TO-CENTER TRUSSES = 19.5 ft

SINGLE TRACK

STEAM IMPACT

HANGERS AT L_1U_1, L_2U_2, L_3U_3

For Type Four Loadings:



INPUT DATA FILE

```
*LIST DATR2

10   4
20 SAMPLE ANALYSIS PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGES
30   8  13   0
40    120.
50   1   2   0.          0 L0L1   0
60   2   3   0.          0 L1L2   0
70   3   4   0.          0 L2L3   0
80   4   5   0.          0 L3L4   0
90   1   6   0.          0 L0U1   0
100   6   7   0.          0 L1U2   0
110   7   8   0.          0 U2U3   0
120   8   5   0.          0 U3L4   0
130   2   6   0.          1 L1U1   0
140   3   7   0.          1 L2U2   0
150   4   8   0.          1 L3U3   0
160   3   6   0.          0 U1L2   0
170   3   8   0.          0 L2U3   0
180   1   0.          0.
190   2    30.0       0.
200   3    60.0       0.
210   4    90.0       0.
220   5    120.       0.
230   6    30.0        30.0
240   7    60.0        40.0
250   8    90.0        30.0
260   3
270   1   1
280   1   2
290   5   2
300   8
310   1   2    10.0
320   2   2    20.0
330   3   2    30.0
340   4   2    40.0
350   5   2    50.0
360   6   2    60.0
370   7   2    70.0
380   8   2    80.0
390   1   5   4
400    100.        18.0
410    200.        20.0
420    300.        10.0
430    400.       0.
440    30.0
450   0   1   1    19.5      0.         0.         0

ready

*
```

```
*RUN BRRTRU

IS DATA TO BE INPUT FROM
EXISTING FILE(Y OR N)   ?
=Y

NOTE# TO RETURN TO PREVIOUS QUESTION ENTER THE
      LETTER R AS A QUESTION RESPONCE.

ENTER NAME OF INPUT FILE
(MAX. 8 CHAR.)
=DATR2
```

SAMPLE ANALYSIS PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGE

8 JOINTS 13 BARS SPAN 120.000

MEMBER		AREA	
1	2	1.000	L0L1
2	3	1.000	L1L2
3	4	1.000	L2L3
4	5	1.000	L3L4
1	6	1.000	L0U1
6	7	1.000	L1U2
7	8	1.000	U2U3
8	5	1.000	U3L4
2	6	1.000	L1U1
3	7	1.000	L2U2
4	8	1.000	L3U3
3	6	1.000	U1L2
3	8	1.000	L2U3

JOINT	COORDINATES	
1	0.	0.
2	30.000	0.
3	60.000	0.
4	90.000	0.
5	120.000	0.
6	30.000	30.000
7	60.000	40.000
8	90.000	30.000

REACTIONS

JOINT	DIRECTION
1	X
1	Y
5	Y

TRUSS IS STATICALLY DETERMINATE

DEAD LOAD

JOINT	LOAD	
1	-10.000	Y
2	-20.000	Y
3	-30.000	Y
4	-40.000	Y
5	-50.000	Y
6	-60.000	Y
7	-70.000	Y
8	-80.000	Y

ASSOCIATION OF AMERICAN RAILROADS RESEARC
H CENTER
SAMPLE ANALYSIS PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGE

LOADING IS TYPE FOUR
ONLY INPUT LOADS CONSIDERED
LOADED CHORD 1 5

	LOAD	SPACING
1	100.0000	18.0000
2	200.0000	20.0000
3	300.0000	10.0000
4	400.0000	0.

THROUGH TRUSS
SINGLE TRACK
STEAM LOADING
1967 AREA SPECIFICATIONS
C-C TRUSSES 19.500

FORCES IN KIPS, LENGTHS IN FT, AREAS IN SQ. INCHES

MEMBER REV	LENGTH	AREA	DEAD LOAD	LIVE LOAD	IMPACT	TOTAL
1 2	30.00 L0L1	1.00	140.	318.	151.	609.
2 3	30.00 L1L2	1.00	140.	318.	151.	609.
3 4	30.00 L2L3	1.00	160.	318.	151.	629.
4 5	30.00 L3L4	1.00	160.	318.	151.	629.
1 6	42.43 L0U1	1.00	-198.	-449.	-214.	-861.
6 7	31.62 L1U2	1.00	-158.	-318.	-152.	-627.
7 8	31.62 U2U3	1.00	-158.	-318.	-152.	-627.
8 5	42.43 U3L4	1.00	-226.	-449.	-214.	-890.
2 6	30.00 L1U1	1.00 HANGER	20.	317.	201.	537.
3 7	40.00 L2U2	1.00 HANGER	30.	201.	127.	358.
4 8	30.00 L3U3	1.00 HANGER	40.	317.	201.	557.
3 6	42.43 U1L2	1.00	14.	-159.	-76.	-221.

					136.	65.	
215.							
3	8	42.43	1.00	-14.	-159.	-76.	-249.
		L2U3					
					136.	65.	
187.							

REACTIONS

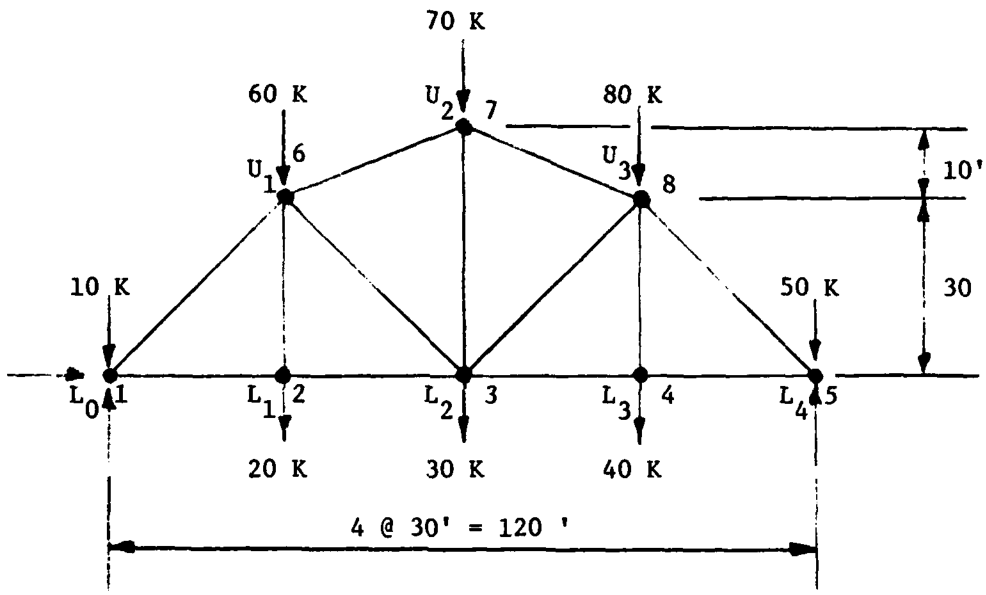
POINT	DEAD	LIVE	IMPACT	TOTAL
1X	-0.	0.	0.	0.
1Y	150.	443.	211.	804.
5Y	210.	443.	211.	864.

*

Example Problem for BRRTRR

SAMPLE TRUSS--8 JOINTS, 13 BARS

FOR BRRTRR--RATING OF TRUSSES



CENTER-TO-CENTER TRUSSES = 19.5 ft

SINGLE TRACK

DIESEL IMPACT

RIVETED CONNECTIONS

HANGERS AT L_1U_1, L_2U_2, L_3U_3

INPUT DATA FILE

```
*LIST DATR4

10 SAMPLE RATING PROBLEM - 120 FT. TRUSS  - CASE TASK GROUP BRIDGES
20 120. 8 13 0 0 0 1 0
30 1 2 0. 22.12 0. 1 0 L0L1 0
40 2 3 0. 25.31 0. 0 0 L1L2 0
50 3 4 0. 25.31 0. 0 0 L2L3 0
55 4 5 0. 22.12 0. 0 0 L3L4 0
60 1 6 50.12 0. 7.10 0 0 U0U1 0
70 6 7 55.33 0. 7.20 0 0 U1U2 0
80 7 8 55.33 0. 7.20 0 0 U2U3 0
90 8 5 50.12 0. 7.10 0 0 U3U4 0
100 2 6 0. 20.16 0. 0 1 L1U1 0
110 3 7 22.15 18.27 8.20 0 0 L2U2 0
120 4 8 0. 20.16 0. 0 1 L3U3 0
130 3 6 24.32 20.16 8.50 0 0 U1L2 0
140 3 8 24.32 20.16 8.50 0 0 U2L3 0
150 1 0. 0.
160 2 30. 0.
170 3 60. 0.
180 4 90. 0.
190 5 120. 0.
200 6 30. 30.
210 7 60. 40.
220 8 90. 30.
230 3
240 1 1
250 1 2
260 5 2
270 8
280 1 0 10.
290 2 0 20.
300 3 0 30.
310 4 0 40.
320 5 0 50.
330 6 0 60.
340 7 0 70.
350 8 0 80.
360 1 5
370 30.
380 0 1 1 1 19.5 0. 0. 0

ready
```

```
*RUN BRRTRR

INPUT DATA FILE NAME IN 8 CHARACTERS OR LESS.
ENTER A CARRIAGE RETURN IF DATA WILL BE ENTERED FROM A KEYBOARD.

=DATR4


INPUT A FILE NAME FOR OUTPUT IN 8 CHARACTERS OR LESS.
HIT A CARRIAGE RETURN IF OUTPUT IS TO BE PRINTED ON TERMINAL.

=OUTR4

*
```

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER
CHICAGO,ILLINOIS
REVISED DEC.1975

SAMPLE RATING PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGES

8 JOINTS 13 BARS SPAN 120.000

MEMBER		GROSS AREA	NET AREA	RADGR	MATL	
1	2	0.	22.12	0.	1	L0L1
2	3	0.	25.31	0.	1	L1L2
3	4	0.	25.31	0.	1	L2L3
4	5	0.	22.12	0.	1	L3L4
1	6	50.12	0.	7.10	1	U0U1
6	7	55.33	0.	7.20	1	U1U2
7	8	55.33	0.	7.20	1	U2U3
8	5	50.12	0.	7.10	1	U3U4
2	6	0.	20.16	0.	1	L1U1
3	7	22.15	18.27	8.20	1	L2U2
4	8	0.	20.16	0.	1	L3U3
3	6	24.32	20.16	8.50	1	U1L2
3	8	24.32	20.16	8.50	1	U2L3

JOINT	COORDINATES	
1	0.	0.
2	30.000	0.
3	60.000	0.
4	90.000	0.
5	120.000	0.
6	30.000	30.000
7	60.000	40.000
8	90.000	30.000

REACTIONS

JOINT	DIRECTION
1	X
1	Y
5	Y

TRUSS IS STATICALLY DETERMINATE

DEAD LOAD

JOINT	LOAD
1	10.000 Y
2	20.000 Y
3	30.000 Y
4	40.000 Y
5	50.000 Y
6	60.000 Y
7	70.000 Y
8	80.000 Y

1

1 ASSOCIATION OF AMERICAN RAILROADS TECHNICAL CENTER

CHICAGO,ILLINOIS

REVISED DEC.1975

SAMPLE RATING PROBLEM - 120 FT. TRUSS - CASE TASK GROUP BRIDGES

THROUGH TRUSS
SINGLE TRACK
STEAM LOADING
1967 AREA SPECIFICATIONS
C-C TRUSSES 19.500
RIVETED CONNECTIONS
FLOOR BEAM CONNECTIONS BOLTED
MATERIAL 1 OPEN-HEARTH

MEMBER	CRITICAL AREA (SQ IN)	LENGTH (FT)	L/R	ALLOW STRESS (KSI)	TOTAL CAPACITY (KIPS)	DEAD FORCE (KIPS)	LIVE CAP (KIPS)
1 2	22.12	30.00		24.00	530.9	140.0	390.9
2 3	25.31	30.00		24.00	607.4	140.0	467.4
3 4	25.31	30.00		24.00	607.4	160.0	447.4

	E80 (KIPS) (NO IMP)	COOPER RATING (40 MPH)	COOPER RATING (30 MPH)	COOPER RATING (20 MPH)	COOPER RATING (10 MPH)	MATL	MEMBER
1 2	236.58	89.5	89.5	89.5	89.5	1	LOL1
2 3	236.58	107.0	107.0	107.0	107.0	1	L1L2

```
       236.58    102.4    102.4    102.4    102.4     1      L2L3

 4  5       22.12    30.00             24.00    530.9    160.0    370.9
       236.58     84.9     84.9     84.9     84.9     1      L3L4

 1  6       50.12    42.43   71.71   -18.29   -916.5   -198.0   -718.5
      -334.58    116.3    116.3    116.3    116.3     1      U0U1

 6  7       55.33    31.62   52.70   -19.07  -1055.4   -158.1   -897.3
      -242.26    200.6    200.6    200.6    200.6     1      U1U2

 7  8       55.33    31.62   52.70   -19.07  -1055.4   -158.1   -897.3
      -242.26    200.6    200.6    200.6    200.6     1      U2U3

 8  5       50.12    42.43   71.71   -18.29   -916.5   -226.3   -690.2
      -334.58    111.7    111.7    111.7    111.7     1      U3U4

 2  6       20.16    30.00             24.00    483.8     20.0    463.8
       172.53    131.7    131.7    131.7    131.7     1      L1U1 H

 3  7       18.27    40.00             24.00    438.5     30.0    408.5
       153.22    144.4    144.4    144.4    144.4     1      L2U2

 4  8       20.16    30.00             24.00    483.8     40.0    443.8
       172.53    126.0    126.0    126.0    126.0     1      L3U3 H

 3  6       24.32    42.43   59.90   -18.80   -457.3     14.1   -471.5
       -79.11    322.7    322.7    322.7    322.7     1      U1L2
      -115.03    222.0    222.0    222.0    222.0     1           R

 3  8       24.32    42.43   59.90   -18.80   -457.3    -14.1   -443.2
       -79.11    303.4    303.4    303.4    303.4     1      U2L3
      -115.03    208.6    208.6    208.6    208.6     1           R
```

ALL STEAM RATINGS ARE FOR FULL IMPACT   47.71 PERCENT   HANGERS   63.33 PERCENT

H IN LAST COLUMN INDICATES HANGER
BENDING STRESSES NOT INCLUDED

R IN LAST COLUMN INDICATES RATINGS ARE FOR MEMBERS HAVING STRESS
REVERSAL. ONE-HALF OF SMALLER STRESS ADDED TO LARGER STRESS

C IN LAST COLUMN INDICATES COUNTER

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

United States. Waterways Experiment Station, Vicksburg, Miss.
Evaluation of computer programs for the design/analysis of highway and railway bridges. Vicksburg, Miss. : U. S. Waterways Experiment Station ; Springfield, Va. : available from National Technical Information Service, 1980.
17, 63 p. : ill. ; 27 cm. (Technical report - U. S. Army Engineer Waterways Experiment Station ; K-80-2)
Prepared for Office, Chief of Engineers, U. S. Army, Washington, D. C.
A report under the Computer-Aided Structural Engineering (CASE) Project.

1. Bridge design. 2. Computer-Aided Structural Engineering Project. 3. Computer programs. 4. Highway bridges. 5. Railroad bridges. I. United States. Army. Corps of Engineers. II. Series: United States. Waterways Experiment Station, Vicksburg, Miss. Technical report ; K-80-2.
TA7.W34 no.K-80-2

[illegible] STATION REPORTS [illegible] UNDER THE COMPUTER-AIDED [illegible] (CASE) PROJECT

	Title	Date
[illegible]	List of Computer Programs for Computer-Aided [illegible] Engineering	Feb 1978
[illegible]	User's Guide: Computer Program With Interactive Graphics for Analysis of Plane Frame Structures ([illegible]FRAME)	Mar 1979
Technical Report K-80-1	Survey of Bridge-Oriented Design Software	Jan 1980
Technical Report K-80-2	Evaluation of Computer Programs for Highway and Railway Bridges	Jan 1980
[illegible] Report K-80-1	User's Guide: Computer Program for Design/Review of Curvilinear Conduits/Culverts (CURCON)	Feb 1980